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WEDNESDAY, FEBRUARY 18, 1976

The hearing reconvened at 9:10 A.M. on Wednesday, February 18, 1976, in the Chambers of the Montana House of Representatives, State Capitol, Helena, Montana.

The Honorable Carl M. Davis, Hearings Examiner, presided over the proceedings:

APPEARANCES:

Applicants:

William M. Bellingham, Esq.
John L. Peterson, Esq.
John Ross, Esq.

Department of Natural Resources and Conservation:

William G. Sheridan, Esq.
Ted J. Doney, Esq.

The following proceedings were had:

DANIEL T. POTTS, appearing as a public witness, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

HEARINGS EXAMINER: As I already advised you, since you do have a written statement, it will be filed in evidence and go to the board in its present form. Mr. Sheridan will ask you some questions on cross-examination, so you may proceed, Mr. Sheridan.

(THE WRITTEN DIRECT TESTIMONY OF MR. DANIEL T. POTTS WAS DIRECTED TO BE INSERTED AT THIS POINT.)

STATEMENT IN SUPPORT OF THE CONSTRUCTION OF COLSTRIP ELECTRIC GENERATING UNITS 3 & 4.

My name is Daniel T. Potts and I am Manager of Administration at the Hoerner Waldorf pulp and paper plant, west of Missoula, Montana.

The Hoerner Waldorf pulp and paper production facility near Missoula produces 1,150 tons of paper products daily, with an employment of approximately 500 people and an annual payroll of over $6.0 million. The manufacture of the mill's two primary products, bleached pulp and linerboard, utilizes 4,000 tons of wood per day, most of which is produced by the lumber and plywood industry in Montana as a by-product of their primary manufacturing process. The use of this "waste wood" by Hoerner Waldorf contributes significantly to the greater utilization of Western Montana's greatest resource, the tree.

While environmental control at the Hoerner Waldorf mill has been of concern since the mill began operations in 1957, recent passage of air and water protection legislation created new requirements, which had to be met by the Missoula mill. In response to these requirements, Hoerner Waldorf installed a large effluent clarifier and began construction of its two-phase air emmission control program in early 1970. When completed, at a total cost of over $15 million, Hoerner Waldorf was able to achieve full compliance with the Montana air emmission standards in January of 1974.

While the result of this program has been a major reduction in the emmission of odorous gases, particulate, and water vapor from the plant, a bothersome odor, typical of Kraft pulp mills, continued to emanate from our complex. As a major step towards reducing this odor which was being generated by our effluent holding ponds and accomplishing the further objective of meeting water quality standards, Hoerner Waldorf completed and started up a secondary effluent treatment system in November of 1974. This system, through the use of large mechanical mixers, introduces large quantities of air into the effluent, thereby reducing the biochemical oxygen demand of the effluent, allowing the mill to reduce odorous emissions from the effluent ponds by 98%, and meet the proposed Environmental Protection Agency water quality standards for 1977 and the still more stringent standards for 1983 pertaining to the biological oxygen demand of the effluent.

What do these environmental protection programs have to do with the proposed Colstrip Electric Generating Units 3 and 4? Well, all of these additional devices are substantial users of electric power. Our air emission control programs at the Missoula mill have increased our usage of electric power by 1,900 kilowatts. Our effluent treatment system utilizes 2,100 kilowatts, bringing our total power consumption to 4,000 kilowatts for the purpose only of environmental improvement. All these devices operate 24 hours a day, 350 days per year, and aggregate 33,600,000 kilowatt hours annually. This is equivalent to the average annual usage of 5,200 residential customers in Montana.

All these devices were installed under the basic assumption that the necessary electric power would be available. As Montana's industries continue to progress in its efforts to further improve air and water quality, additional supplies of electric power will undoubtedly be required. A growing supply of this basic resource, energy, is therefore necessary if we are to both achieve our objectives of improved environmental quality and maintain our high standard of living. For this reason, Hoerner Waldorf supports the construction of additional electric generating facilities at Colstrip and the necessary transmission facilities.

Daniel T. Potts, Manager of Administration

EXAMINATION OF DANIEL T. POTTS

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Mr. Potts, from reading your statement, are you trying to infer at the present time that Hoerner-Waldorf has not experienced complaints from the residents in Missoula, Montana, as a result of the emissions from your plant?

A I would say that at the present time the number of complaints are very substantially reduced compared to the level that they were previously.

Q There are still a substantial number of complaints regarding your operations, are there not?

A I have no personal knowledge of any substantial number of complaints, no.

Q What is your job at the plant?

A I am in charge of, as manager of administration, I am in charge of, largely, of public relations and, also I am in charge of purchasing and industrial relations.

Q You're in charge of public relations for the plant, and you don't have any knowledge of any complaints; is that it?

A I didn't say I had no knowledge of complaints; I said that at the present time I have no personal knowledge of a large number of complaints.

Q What complaints are you getting now?

A I have not personally received a complaint about the operation of the mill in several months, sir.

Q From either state agencies, the medical association, or citizens?

A None, none.

Q How long ago, three months?

A I said several months, two or three months.

Q Two or three months?

A Right.

Q Not much more than that, though, is it?

A Well, we have emerged from a rather significant controversy regarding the expansion of our mill during which time there was a lot of public discussion of the effects of our mill on the environment in the vicinity of Missoula. However, it is in my mind without question that Hoerner-Waldorf has made very significant progress in reducing our impact in the area as far as the effects on air quality are concerned, and, as a result of that, we have not experienced any serious complaints that I'm aware of.

Q And that's your opinion?

A Yes.

Q Mr. Potts, essentially, I think what you're telling us is you need electricity in order to operate your pollution control devices, right?

A That's correct.

Q Did you ever make any studies at Hoerner-Waldorf to determine how much power could be generated by capturing the excess steam from your facility?

A We have underway -- you say electric power?

Q How much power could be generated through the use of the steam which is now emitted from the plant?

A I don't believe that currently the steam that is now emitted from the plant, at least as we've studied it to date, would allow the generation of any electric power.

Q You know the Dow Study found that Missoula had at the Waldorf plant approximately 35 megawatts of capacity there?

A I am not aware of any such study.

MR. SHERIDAN: No further questions.

HEARINGS EXAMINER: Very well, Mr. Potts, your statement will go to the board, and thank you for coming.

(WITNESS EXCUSED)

HEARINGS EXAMINER: All right, your next witness, Mr. Sheridan.

MR. SHERIDAN: Do you have any more public witnesses, Mr. Davis.

HEARINGS EXAMINER: There are none other present.

MR. SHERIDAN: At this time the Department of Natural Resources will call William Brewer. We will tender the statement of William Brewer and exhibits 110 through 115. I believe certain corrections have already been put into the record with respect to Mr. Brewer's statements, so I won't go into them at this time.

MR. BELLINGHAM: I don't know that I have any record of these corrections. Yes, I guess perhaps I do. They were just a few.

MR. SHERIDAN. Typographicals.

WILLIAM A. BREWER, called as a witness by the Department of Natural Resources and Conservation, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

HEARINGS EXAMINER: Mr. Bellingham?

MR. BELLINGHAM: At this time the applicants move to strike Exhibit 115 and object to the introduction of such exhibit on the grounds that it's a study prepared by someone who will not be present for cross-examination. It constitutes heresay, and insufficient foundation has been laid for its admittance. Furthermore, there appeareth therein various omissions, and I am referring now to the various parensis marks which appear in there, apparently for the use of footnotes of some kind. For example, in line 3 of the first page, line 2 of the second page, line 3 of the second page, and so forth throughout the study. Also, apparently, there should be, or there was intended at least to have a bibliography of some kind attached to the study, as evidenced by the parensis marks for the use of footnotes; but the bibliography, of course, is not attached and, accordingly, we do not have access to it. We feel that footnotes and bibliography are an intrical part of the study without which we are not in a position to analyze it and go over it in a way that we should be in a position to do so.

HEARINGS EXAMINER: I'll reserve any ruling on the admission of the exhibit to your motion until you finish your cross and re-cross.

(THE WRITTEN DIRECT TESTIMONY OF MR. WILLIAM A. BREWER WAS DIRECTED TO BE INSERTED AT THIS POINT.)

STATEMENT OF TESTIMONY OF

WILLIAM A. BREWER

I am William A. Brewer, an engineer and geologist currently employed as Research Professor, University of Washington, Seattle. I hold the Bachelors and Masters Degrees in Economic Geology and a Doctorate in Engineering, all from the University of California, Berkeley. I have also completed work at Harvard University, Graduate School of Business Administration, under the Program for Management Development. I have over 20 years of managerial experience in engineering, resource development, technical intelligence and energy systems analysis. My professional registration is in the state of California.

For two years I was Executive Director of the Washington State Energy Policy Council, and I still serve as a consultant to Washington state agencies as well as private firms.

FOREWORD

"It is as true of power plants or automobiles as it is of biological populations that the earth cannot sustain any physical growth for more than a few tens of successive doublings. Because of this impossibility, the exponential rates of industrial and population growth that have prevailed during the past century and a half must soon cease. Although the forthcoming period of stability poses no insuperable physical or biological difficulties, it can hardly fail to force a major revision of those aspects of our current social and econonic thinking that stem from the assumption that the growth rates that have characterized this temporary period can somehow be made permanent."

This statement was made by M. King Hubbert, in 1971.

1. Both the date and the authorship of this statement are significant. Fifteen years earlier Hubbert correctly identified the inevitable cycles of depletion of the fossil fuels, and correctly identified the bases for the "Energy Crisis" which became prominent less than two years later. Far from being a gloomy prophet, he, along with many colleagues in geology, engineering and the mathematical sciences, predicts that during the "forthcoming period of stability," both developing and wholly new technologies will permit the utilization by society of traditional as well as exotic energy resources for periods extending far beyond the planning of existing organizations.

But most serious studies of future energy supply-demand relationships require both parts of Hubbert's picture to arrive at non-catastrophic solutions; alternative energy technologies and the end of high exponential growth rates in energy demand are required.

This condition, which is essential for the avoidance of disaster, does not require the end of growth or development in most of the other traditional units of analysis; population, the gross products of regions and nations, real per-capita income, even economic rents from ownership of resources and production should be capable of sustained expansion. As a matter of fact and, increasingly, as a matter of record, real economic improvement in this country requires that energy growth rates be sharply reduced relative to the recent past. I refer not only to the requirement for curtailing imports of energy and energy products, but also to the demonstrated need for conservation of all those domestic resources whose supply is finite, and whose highest and best use is something other than simple combustion. These sorts of conclusions are not based on pious hope or metaphysical leaps, but on straightforward, dollars and cents analyses of the situations which confront us today. We will examine one such real situation in considerable detail later in this testimony. But to finish the introduction on a hopeful note, there is one very important development which strongly buttresses our case, but which could not have been counted upon even a year ago:

We finally "turned the corner" in energy consumption, in the year 1974. Preliminary figures released by the U. S. Bureau of Mines in 1975 showed an energy use decline of 2.2% for the country as a whole, for heat, light and power in all forms. 1974 was a year of economic downturn, but that was only one factor among many others, and of those others, some of the most significant factors had their beginnings several years ago, that is, in periods of normal economic growth.

I will attempt to demonstrate in this analysis that Northwest power consumption represents one of those changed circumstances, relative to the recent past. In other words, the growth rate of electricityuse in the Northwest is not, today, and will not be, tomorrow, what it has been for the past two decades, and in this change of circumstances the Northwest reflects national trends.

Let me note here that this prediction is conditional, the condition being that producers of electricity do not create, by means of overcapacity, a future situation in which they are forced to develop new markets for electricity which are in excess of those which would otherwise develop through normal growth, extrapolated in response to normal influences, and identified for planning purposes through normal sectoral forecasts. The great importance of forecasts in electrical planning will become apparent, and is in fact my main topic.

2. Scope of This Analysis, Background

My principal thesis is that the method of demand forecasting employed by electrical utilities in the Pacific Northwest tends to result in artificially high, "inflated" estimates out toward the end of the forecast period. This occurs in part because the method is largely *projective*, depending on the continuation of past growth rates to obtain the slope of future growth curves. While such a method may have been satisfactory since the beginning of coordinated regional forecasting (in the late 1940's) and through the 1960's, the satisfaction formerly obtained with it depended on circumstances which have now changed. And becauseof these changes, which mounting evidence indicates are long-lasting if not permanent ones, a different method of forecasting is required. The proposed method, which has not yet been fully adopted by the utilities but which has been exercised in elementary form by myself and others, is the sectoral forecast, which assigns each increment of past or present electrical consumption to an identifiable sector in the consuming society, and bases estimates of future load growth on parametric changes within the sectors, to reach a total figure based on the combination of many, and better-known trends, rather than one, artificial trend as in the case of projective forecasting.

The only universally true statement that can be made about forecasts is that they are invariably wrong. The degree of incorrectness, the accuracy, is what must concern us here. I will use evidence directly from utility forecasts to indicate that even fairly recent ones are not turning out to be accurate, even within the limits of guesswork, and most importantly, that they generally turn out to be incorrect on the "high" side; they have predicted load growth that did not materialize.

Then I will present alternative estimates, at the elementary level certainly, but based on sectoral principles as previously defined, which suggest that future load growth in the Pacific Northwest will be lower by far than the utilities' current forecasts. The importance of the difference between "high" and "low" forecasts will be shown to be of extreme consequence in the 1980's and beyond, in many facets of economic, environmental and social concern. Possible explanations of the origin of the controversy demonstrated in these hearings will be presented.

A successful case-building effort would, I believe, convince the Board that, as a whole, the current electrical growth forecasts beyond about 1980 are inflated by a factor which increases with each passing year, to the point that by the mid-90's, the end of current forecasts, the predicted energy load defies common sense. (These forecasts are known as the "West Group Forecasts" and are prepared by the Pacific Northwest Utilities Conference Committee.)

It is proposed, by way of partial explanation, that the private utilities of the Northwest have to some extent become victims of a rate-of-return system which they and the public helped to create together, but which no longer serves stockholder or management interests, or the broadly-defined public interest. Also, it is difficult to deny that overall growth in their generating facilities and consequent sales, regardless of the end-use, will increase their net profits under the fixed rate-of-return system. Finally, all of us, including private and public utilities, are experiencing a cultural problem in accepting the end of the high growth rates which have prevailed throughout our lifetimes - high growth rates in population, resource use, physical development and the use of energy in all forms. We are accustomed, and indeed often commicted to the doubling and redoubling of everything -

incomes, goods, services and energy consumption - in periods on the order of a decade, and calling this "historic" growth.

3. Doubling Times

The concept of "doubling" is as useful in understanding electrical growth rates as it is in compounding the interest on an investment. In the ten year doubling case cited above, a compound growth rate of 7.2% per year, maintained for ten years, will increase the original quantity by a factor of two -- producing a doubling. Ten more years growth at the 7.2% rate produces four times the original quantity, another ten years growth produces an eight-fold increase, and so on. For a 7.2% growth rate, we say the "doubling time" is **ten years.**

For the consideration of other growth rates, it is useful to remember that the number 72, divided by the percentage of annual compound growth, gives approximately the number of years in the doubling times. Electrical load growth of 6% annually requires doubling the total generating capacity about every 12 years, while a 3% load growth rate allows about 24 years to double capacity. One percent growth, which is roughly the U.S. population growth rate today, doubles in about every 70 years.

4. Northwest Electrical Load Forecasts, Trends and Accuracy

For nearly thirty years combined (interstate, and interutility) load growth forecasts have been published to cover the Pacific Northwest. At this time the "West Group Forecast" (WGF) is the most widely accepted; it covers the states of Washington and Oregon, all of Northern Idaho, plus smaller contiguous areas of Southern Idaho, Western Montana and Northern California. Included in WGF are loads and resources of the significant private, public and federal utility systems, except the Idaho Power Company; Bonneville Power Administration (BPA) provides total system reporting services on a monthly or sometimes weekly basis, while the WGF is published annually, usually in February.

In the past, the WGF was a fairly accurate indicator of load growth several years in advance of its materialization. Both loads and resources were growing rapidly relative to the small, post-World War II base, at annual percentage rates on the order of five to six percent compounded. Forecast growth curves tended to average toward lines which were smooth and exponential, as illustrated in Figure 4-1 (Exhibit 110), which covers the years 1956 to 1971, even though the slopes of the curves varied.

Looking at the "actuals" for this period, vs. the forecast, one would conclude that not only were the forecasts fairly accurate, they were also fairly conservative; at least through 1969, actual loads materialized faster than foreseen in 1955, and in 1960. Even in 1965, the 1968-69 "bulge" was not forecast. Averaging over the period 1958 to 1969, and using the "rule of 72" to estimate growth rates, we see that the energy, but not the peak load, doubled from 5,000 MW to 10,000 MW in 10 years, so that the actual, average load growth rate was roughly 7.2% compounded.

Now, if one looks at recent publications and statements of Bonneville and the utilities, it is generally this period of history which is being cited to make the case for projected future growth rates, currently at around five percent. A good example is found on page 22 of The Electric Energy Picture in the Pacific Northwest, Bonneville Power Administration, January, 1975. BPA uses the period mid-1964 to mid-1974 for illustration. I believe this practice is misleading, and wholly neglects an important series of events which began about 1968, [which had a very cold winter, causing unusual peak loads] or 1969.

Figure 4-2 (Exhibit 111) shows the period of 1962 through the 1980's, on the same scale as 4-1 (Exhibit 110), and with data from the same sources. The West Group Forecasts used are those of 1963, which was similar to most immediately previous forecasts in the steepness of its curve; 1968, which had a very high growth rate, presumably in reaction to the "bulge" of the late 1960's; and 1974 and 1975, the latest available at this writing. [I note that the 1976-77 WGF has been delayed until March, 1976. It will be reviewed with great interest.]

Examination of 4-2 (Exhibit 111) "shows" that the 1963 WGF was extremely close to the mark. By contrast, I interpret the high-growth rate 1968 WGF as a "panic" reaction to the late 1960's "bulge." The 1975 WGF, prepared in late 1974, in effect maintained the same overall growth rate as the 1974 WGF, but set the forecast growth back by one year.

But the most surprising development illustrated in 4-2 is the great flattening of load growth, relative to all the forecasts, which began in 1969 and which now has become an absolute flattening, beginning about 1973-74.

At the present time (at the end of January, 1976), the West Group area is about 2,000 MW below the latest forecast in average, firm energy demand. For the latest data months, September through November, 1975, energy load growth has been only 3.03% over the same three month period in 1974. The implications of this are of increasing interest, in that it continues without a break. The trend of lower growth rates began in 1969, and 1969 still appears to mark a significant departure from the past, or "historic" trend. Before going into more detailed analysis, however, it is instructive to compare our Pacific Northwest experience with that of the United States overall.

5. National Load Forecasts and Trends

In May, 1975, the Federal Power Commission (FPC) compared electrical generation in the United States for the years 1972 through 1974. Figure 5-1 (Exhibit 112) shows the FPC summary, as a graphic illustration.

Rather clearly, the U.S. and the Northwest have had a common experience; 1973-74 initiated a very low growth period, even a negative one in some cases. Since then various reporting periods show "growth" ranging from negative to about 2.8% (e.g. for first quarter 1975 over first quarter 1974). Various explanations have been put forward, by FPC and others; the fact remains that both here and nationally the "go-go" electrical growth rates of the 1960's have died out, and numerous policy actions have since been taken by states, federal agencies, firms and householders to ensure that they will not return.

In August, 1975, FPC further compared actual growth to projected growth, for the 13 month period December, 1973, through December, 1974, with the result that there was a national 6.6% decrease from projected requirements, or a "saving" of over 88 million megawatt-hours. More recently, a comparison of 1975 (11 months) to both 1973 and 1974 found that while electrical growth had been 5% over a two-year period, it was almost 9% below projections for the same period (Figure 5-2 (Exhibit 113)).

Thus, any argument that the Northwest is somehow anomalous must deal with the fact that we are sharing, very closely, the experience of the rest of the country, on the same time scale, and with comparable figures. However, our current (Northwest) 2,000 megawatt decline from projected consumption is a discrepancy of over 14%, and this perhaps justifies separate examination of our forecasting methods vs. those elsewhere. That is, in my view; our most current (1974-1975) West Group Forecasts now appear to be more divergent from actual consumption than is the case nationally. This indicates to me that there is somehow "built-in" to our technique an inflationary mechanism, relative to the underlying factors which operate today to create normal demands in the Northwest.

At the national level, many lists have been compiled of the factors which may have caused the drop in electrical growth rates; no serious investigator has attempted to quantify or otherwise allocate them, which seems eminently sensible. The plain fact is that no one knows for sure which factors induce what effects. But certainly demand elasticity, the drop in demand when a commodity rises in price, must be near the top of the list. Secondly, "conservation" in the form of waste reduction or elimination is a particularly potent factor because, by definition, once waste is discovered and corrected, no rational person is going to reinstitute it.

Recovery from the economic downturn/recession since 1973-74 undoubtedly will increase electrical demand, although (at least in the Northwest) economic output would truly have to leap in order to really affect gross demands for firm electrical energy, relative to present economic activity (See Figure 5-3 (Exhibit 114)). Conversions to electrical space and minor process heat (i.e., away from oil and gas) are on the upturn, but even at today's electrical rates, likely to be the lowest ever, there is an extreme economic penalty in residential or commercial electrical heating (on a per-BTU basis), and as electrical rates rise, the conversion trend should taper off.

The "penalty" I refer to is the higher operating costs of electrical heating systems over those fueled by combustion. When electrical heating is "sold" for a new residence or a new process, there is often a first-cost advantage to the owner in going all-electric, but even at the much lower rates in parts of the Northwest today, the cost for a given amount of heat is generally above that for the same amount of heat from fuels, and as electrical rates are forced upwards through load growth, the penalty increases sharply. To illustrate, if residential electrical rates rise to an average three cents per KWH, the home-owner is paying about ten dollars per million BTU for heat, what effects. But certainly demand elasticity, the drop in demand when a commodity rises in price, must be near the top of the list. Secondly, "conservation" in the form of waste reduction or elimination is a particularly potent factor because, by definition, once waste is discovered and corrected, no rational person is going to reinstitute it.

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The "penalty" I refer to is to higher operating costs of electrical heating systems over those fueled by combustion. When electrical heating is "sold" for a new residence or a new process, there is often a first-cost advantage to the owner in going all-electric, but even at the much lower rates in parts of the Northwest today, the cost for a given amount of heat is generally above that for the same amount of heat from fuels, and as electrical rates are forced upwards through load growth, the penalty increases sharply. To illustrate, if residential electrical rates rise to an average three cents per KWH, the home-owner is paying about ten dollars per million BTU for heat, whereas at fifty cents per gallon, heating oil costs about $3.50 per million BTU.

Things are different today in the Northwest in many respects, although it is unlikely that, over time, we can prevent a general coalescence with the national electrical environment. Still, Northwest employment growth at least has not suffered all that much, by comparison with the decline in electrical growth; See Figure 5-3 (Exhibit 114).

But in these or other comparisons, I believe it is even more instructive to examine what did happen in the 1956-71 period (Figure 4-1, (Exhibit 110)), for the causes of high growth, than it is to hypothesize about what might happen in the period to 1985 (Figure 4-2 (Exhibit 111)).

First of all, in that period the Northwest light metals industry, including the "firm" part of its firm-plus-modified firm-plus-secondary power allocation grew rapidly, to the point where today it consumes roughly a quarter of all Northwest electrical energy. Yet through 1985 and beyond, its growth is limited by rule to about 1/4 of 1% of the total energy load on an annual basis. Of the two plants still in development, one the ALCOA Addy, Washington, magnesium plant, will utilize only surplus energy, while the second, Alumax, in Oregon, may never be completed, depending on the results of litigation. Thus for projective purposes, aluminum industry firm demand is close to a constant and is not a growth area.

Next, population growth was above national averages in the period, as was the intensity of "people related" usage, e.g., through all-electric residential rates. Both these trends have changed, along with the striking downward change in overall U.S. population growth, and today only modest population growth is foreseen through the rest of the century.

Finally, the 60's were an era of heavy BPA and utility promotion of any and all electrical uses, on the (perfectly accurate) basis that "the more we used, the lower the real cost to each of us." That trend ceased here and nationally in the late 60's, and will never return, at least until fusion or solar power becomes "too cheap to meter." Through the 70's and increasingly thereafter, electrical energy will become ever more costly in real or current dollars, to the point that investments in better insulation, more compact homes and more efficient commercial and industrial equipment will pay their own way as alternatives to more electrical consumption.

We cannot expect the current "flat" growth curve (of Figure 4-2 (Exhibit 111)) to continue at its suggestive, seductive one-or-two percent rate for long; a maturing population, some more energy substitution and general economic recovery will certainly raise it. The point here, however, is that the driving forces of five, six or seven percent annual growth rate period have largely been removed, and only an unwise, unwarranted and unrevealed return to heavily promotional, high-intensity marketing policies could preserve the "historic" trends. On the contrary, I believe the 60's and early 70's will increasingly be viewed as anomalous, the last gasp of the high-energy-growth era in the United States. Other countries with equal GNP and living standards have learned to live on far less energy, including electrical energy, nearly a generation ago.

6. Conclusions, Predictions and Alternatives

While I believe there is sufficient factual evidence to seriously question, if not to negate the West Group Forecast of 1975 and all its predecessors since 1968, that hardly solves the immediate problems of site approval and scheduling for individual generating units within the overall system, and of individual utilities or consortia of utilities who foresee load growth in their own service areas which is beyond their existing capacity to serve.

The fact that the State of Montana has also made energy growth and growth projections an important element in these hearings is creditable and enlightened. The fact that I appear as a witness for a State agency which is in opposition to the siting of Colstrip Units 3 and 4 does not necessarily mean that I have an axe to grind relative to the specific units in question -- the plain fact is that I am not knowledgeable on the local impact of the Colstrip 3 and 4 development. I have been told that in this case, as is customary, my background and general credibility will be examined in order to bring out any possible bias or technical deficiencies in my testimony. In hopes of conserving time and effort on the part of counsel for the applicants, I will stipulate to the Board that (1) I am indeed an "environmentalist" to the extent that I personally consider the "total environment" - physical, social and economic- to be superior in long-term concern and public priority to the interest of any or all private business concerns or individuals; (2) I am not a "no-growth" advocate, because I am cognizant (in the technical sense) of mid-term continued increases in the

6. Conclusions, Predictions and Alternatives

While I believe there is sufficient factual evidence to seriously question, if not to negate the West Group Forecast of 1975 and all its predecessors since 1968, that hardly solves the immediate problems of site approval and scheduling for individual generating units within the overall system, and of individual utilities or consortia of utilities who foresee load growth in their own service areas which is beyond their existing capacity to serve.

The fact that the State of Montana has also made energy growth and growth projections an important element in these hearings is creditable and enlightened. The fact that I appear as a witness for a State agency which is in opposition to the siting of Colstrip Units 3 and 4 does not necessarily mean that I have an axe to grind relative to the specific units in question -- the plain fact is that I am not knowledgeable on the local impact of the Colstrip 3 and 4 development. I have been told that in this case, as is customary, my background and general credibility will be examined in order to bring out any possible bias or technical deficiencies in my testimony. In hopes of conserving time and effort on the part of counsel for the applicants, I will stipulate to the Board that (1) I am indeed an "environmentalist" to the extent that I personally consider the "total environment" - physical, social and economic- to be superior in long-term concern and public priority to the interest of any or all private business concerns or individuals; (2) I am not a "no-growth" advocate, because I am cognizant (in the technical sense) of mid-term continued increases in the

Northwest population and the resultant basic economic and human needs; and (3) I am aware of and reasonably knowledgeable of the possibilities of electrical load growth in the short-term being a special case relative to growth in total energy demand.

My direct testimony to the Board, then, hopefully, can be confined to Northwest electrical load growth rates - past, present and future - and to their underlying causes and their long-term implications for new plant siting in general.

But this in itself leads to an evident conclusion: Colstrip 3 and 4 are not essential to serving overall, Pacific Northwest loads in the time frame for which they are being proposed, even though they may well be economically attractive options open to the applicants today. Nuclear generation facilities located in Washington and Oregon will certainly be more costly to build, and perhaps also to operate, but I note that the same applicants are also engaged in this alternative type of development, including new, joint participations announced in late January; and I further note that testimony to the State of Washington's Thermal Power Plant Site Evaluation Council by the Washington Public [emphasis added] Power Supply System in late 1975 strongly suggests that their own nuclear power plant development schedule provides for the availability of some excess capacity in roughly the same time period. For example, WPPSS 5, the second unit at Satsop, Washington, was identified as relatively uncommitted at the time of startup. [In my view, the "great unknown" in all this is Bonneville. BPA policies and actions relative to load growth could make, or break, any interstate or interutility agreements to rationalize and to share the burdens and rewards of moderated, planned and conservative electrical development.]

This implies that there is some great uncertainty about the future growth of "normal" demand, to which I do not subscribe. As part of the conclusion of this statement of testimony, I introduce the results of a long-range electrical demand projection developed for me, under my supervision and control, largely by my colleague, Professor George Hinman, of Washington State University. It is entitled Energy Forecasts for the Pacific Northwest, and is identified with my testimony as DNR Exhibit 115. I believe it takes my exposition of past and present trends consistently and logically into the future.

The long-range projection includes all energy forms, and several sets of sectoral forecasts were made using different assumptions about Northwest population growth rates, saturation of electrical usage, the prices of competing energy forms (especially oil) and the probable "mixes" to be expected in 1980, 1990, and 2000. The "base year" is 1971, for which we have good sectoral data. While the actual tabulations are extensive, and highly qualified, it is useful to inspect the electrical growth rates, expressed as above in terms of annual, compound percentages of growth, for the more likely cases.

First, however, we must put a constructive price on electricity itself. For purposes of the particular cases cited below, it is assumed that electrical energy will be available at 20 mills/kwh for residential and commercial uses, and 13 mills/kwh for industrial use, expressed in constant 1973 dollars, while crude oil brings $11/bbl in the same context.

(Other cases and assumptions are examined in much more detail in Exhibit 115.)

With this assumption, and assuming a fairly high population growth rate and a high price response (high elasticity), electrical growth rates are expected to average about two percent between now and the year 2000, increasing toward the end of the period. Lower population growth produces an opposite effect; in households for example, the 5.9% growth rate of 1960-1970 decreases to 2.1% for the decade to 1980, to 2.2% through 1990, and to 1.8% through 2000. In commerce and manufacturing the range declines from 3.6% (1971-1980) to 2.4% (2000). In extractive industries (farming, forestry, mining), the corresponding figures are 5.1% (1971-1980) falling off to 2.9% (2000).

While it is essential to consult the Exhibit 115 for methodology and details of the assumptions, the overriding point here is that none of the assumptions and none of the cases above produces a forecast electrical growth rate like those of the past, and that by the beginning of the 1980's, growth rates between 2% and 3% annually are going to be the norm, in even the highest-growth sectors. And while the details of argument may vary, in order to refute the results of the sectoral forecast, its opponent must commit himself to specific numbers relative to a particular sector, and to an identified time frame. To put it bluntly, one can no longer hide his biases or hopes in the lumped totals, but rather he must come out and say where, when and how the growth is going to occur.

Recently a long look was taken at the various reasons why we resist lower-growth energy projections. Among the expected ones, like technical change and low population growth, worth our consideration here are two:

> "1. Facile reliance on past relationships between sets of time series that have exhibited sturdy constancy in the past, but which may hide internal divergencies liable to break loose during the projection period. More generally formulated, this can be stated as the reliance on relationships of which the inherent logic is not understood but which seem to offer convenient calculating opportunities.
>
> 2. Failure to tell the consumer in unmistakable terms the purpose of the projection, so that he will not misuse it."

Summary

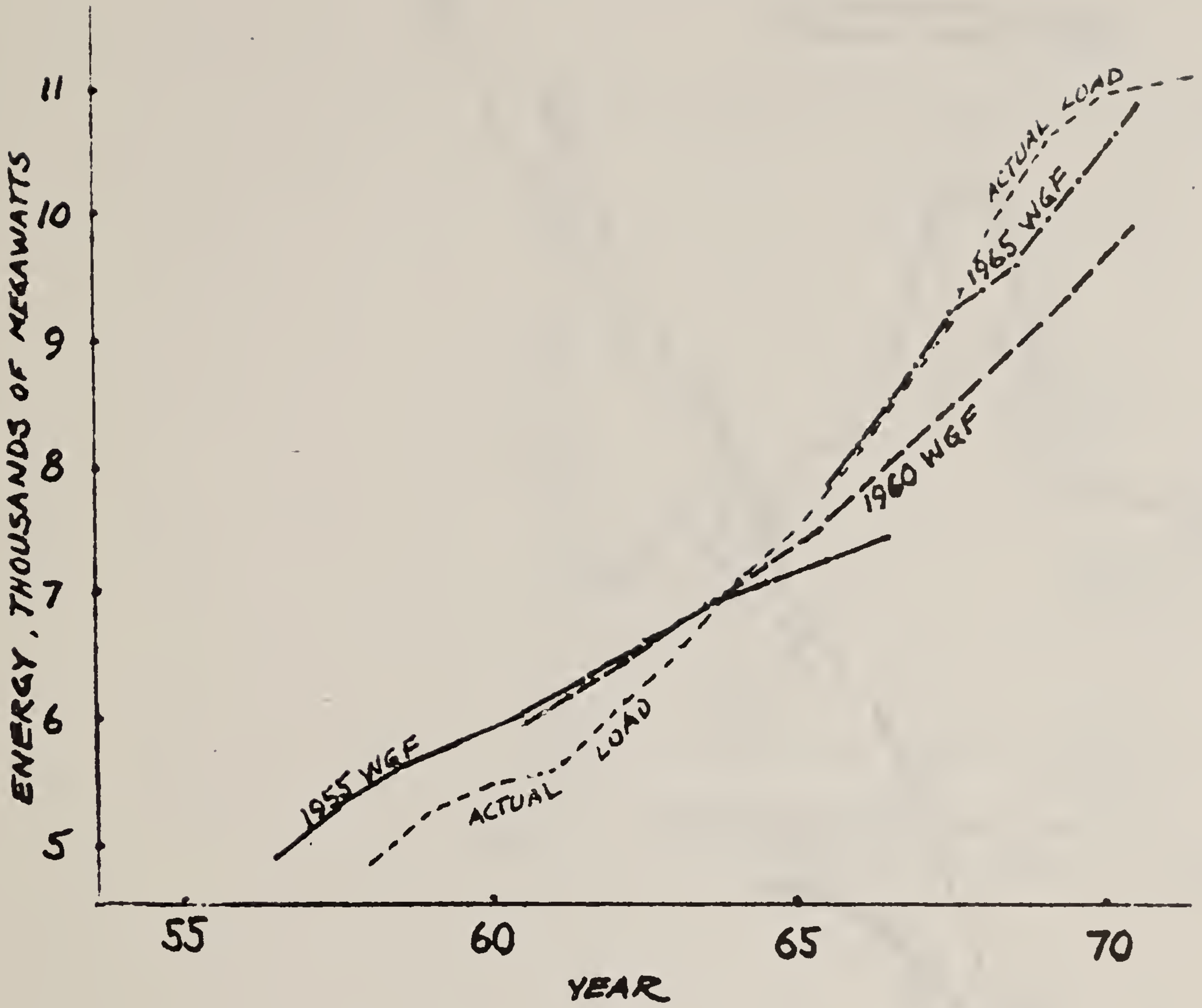
To close this statement, I would summarize the argument as follows:

1. Past high rates of exponential growth in demand in the Northwest, and nationally, have in fact tapered off through the action of both natural and economic factors, and their original driving forces are continually being removed through new policy actions.

2. The forecasting techniques of the 1960's, such as they may be, have at best become obsolete, and in fact are producing bad estimates for the planning of future facilities.

3. While some load growth will certainly prevail, it is likely to be at half of the previous annual rates,

providing for roughly twice the amount of time for new base load generation to be developed, relative to the past.

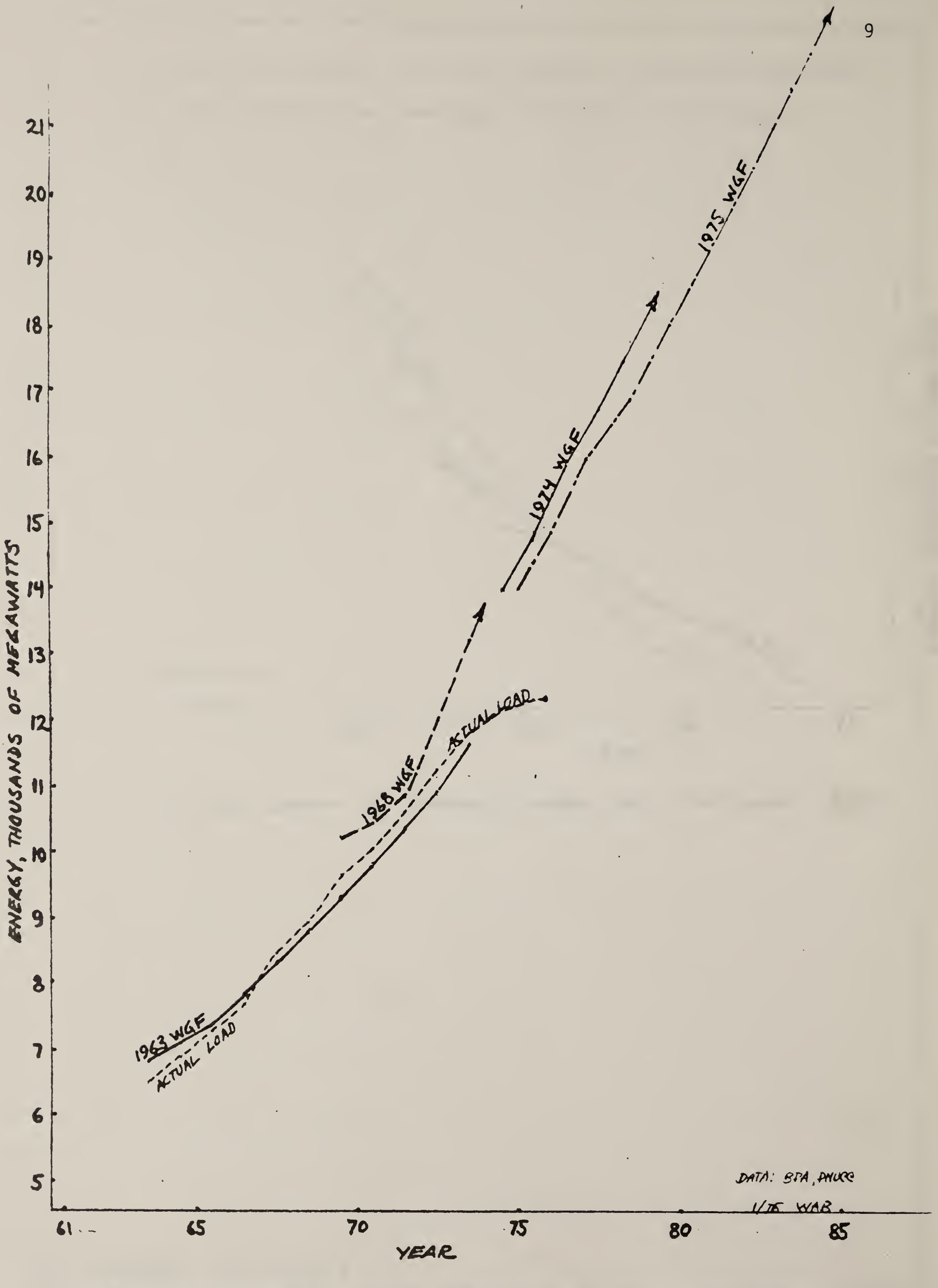


DATA: BPA, PNUCC

1/75, WAB

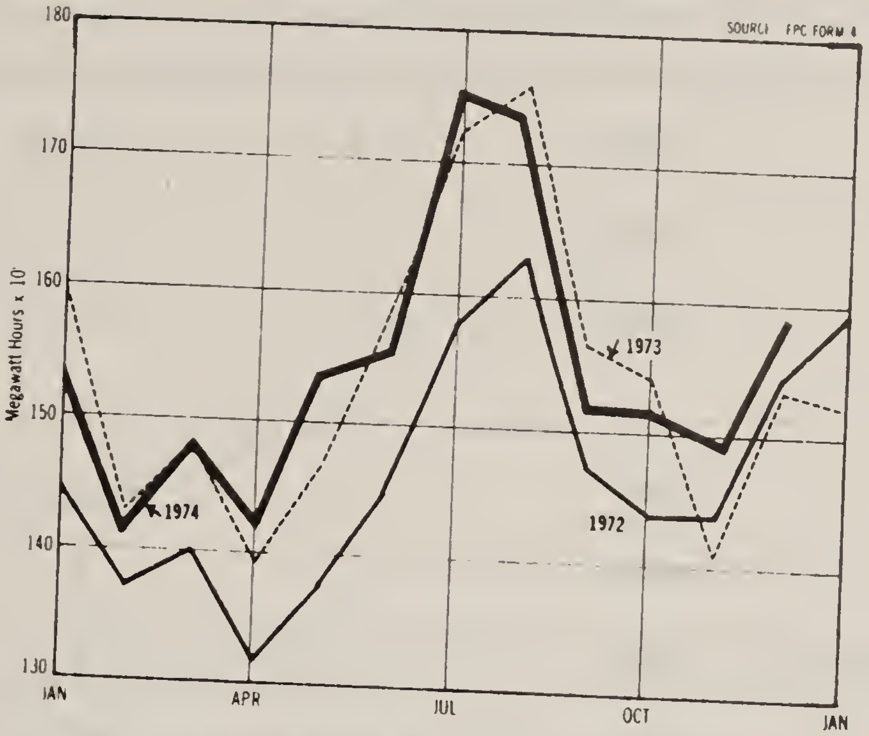
4-1. FORECAST LOAD GROWTH CURVES vs. ACTUALS, 1956-71

Figure 4-1 EXHIBIT 110



4-2 FORECAST LOAD GROWTH CURVES VS. ACTUALS, 1962 - 85

MONTHLY NET GENERATION OF ELECTRIC POWER BY
U.S. ELECTRIC UTILITY PLANTS, 1972, 1973, 1974



5-1.

The total monthly generation is given as a point for the month indicated
The lines merely connect sets of points to identify the year

DATA: FPC
5/75

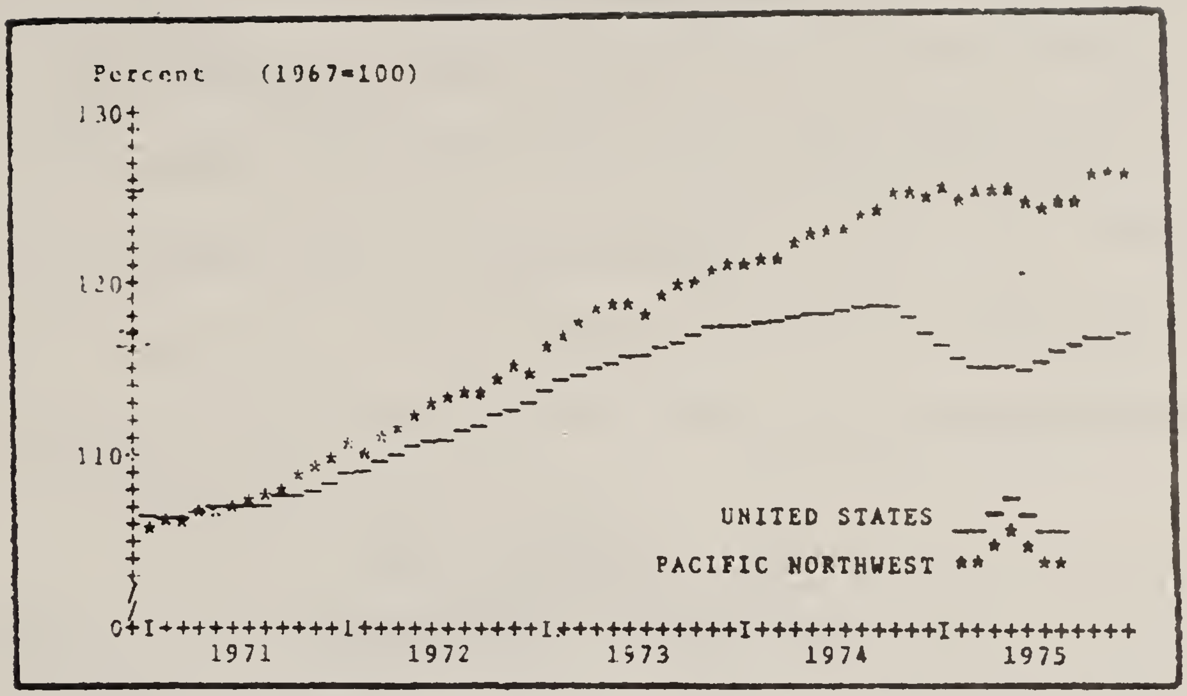
EXHIBIT 112

HOW ARE WE DOING -- January 1, 1976

	YTD	Vs. 74	Vs. 73	Vs. Trend
Total Energy	Sept.	-2.2	-4.6	-12.3
Buildings	Aug.	+3.7	+1.4	- 7.8
Transportation	Aug.	+1.7	-2.7	-11.6
Industry	Aug.	-10.3	-12.0	-17.8
Gasoline	Nov.	+ 2.2	- 1.1	- 9.4
Total Petroleum	Nov.	- 1.1	- 6.0	-14.8
Total Petroleum Imports	Nov.	+ 1.3	- 8.1	NA
Electrical Output	Nov.	+ 2.0	+ 5.0	- 8.9

Figure 5-2

EXHIBIT 113



U.S. DEPARTMENT of Labor graph shows the percentage gain in national employment compared to pacific Northwest levels. In 1975, Pacific Northwest employment grew about 10 per cent more than national employment.

Figure 5-3 Exhibit 114

ENVIRONMENTAL RESEARCH CENTER
WASHINGTON STATE UNIVERSITY
PULLMAN, WASHINGTON 99163

SEPTEMBER 1975

ENERGY FORECASTS FOR THE PACIFIC NORTHWEST

EXHIBIT 115

ENERGY FORECASTS FOR 1980, 1990, AND 2000 IN THE PACIFIC NORTHWEST

A. Base Energy Projections for Households and Industry

The prescriptions used to make the base forecasts are described in this section. The forecasts proceed forward in time from 1971 and make use of the distribution obtained previously for that base year ( ). It is important to remember that the base forecast assumes that energy prices remain at 1971 levels, i.e., that energy is neither decreasing nor increasing in price during the rest of the century. The price adjusted forecasts take account of increased prices and scarcity.

Households. The energy consumed by households was calculated as the sum of energy used in private automobiles plus energy used in residential appliances.

A. Energy for private automobiles. The basic methodology was to use household income and household size elasticities to project forward from 1971, i.e., to use

$$C_t = C_{1971}\left(\frac{I_t}{I_{1971}}\right)^{\gamma}\left(\frac{H_t}{H_{1971}}\right)^{\delta}$$

where C_t = private automobile consumption per household in year t

I_t = average household income in year t

H_t = average household size in year t

γ = average household income elasticity = 1.00

δ = average household size elasticity = -0.07

The household sizes used were taken from a report of the Bonneville Power Administration ( ). The household incomes were derived by multiplying per capita incomes from the OBERS forecasts ( ) by the household sizes. In the actual preparation of the tables, the entries for household petroleum transportation for Series C were calculated as shown above, and the Series E entries were derived from them by multiplying by the Series E to Series C population ratios, a slight over-correction. The values used are given in the table below for Series C and E.

Table III-1

Household Sizes and Household Incomes (1967 Dollars)

Region	1970			1980			1990			2000		
	Size	Income		Size	Income		Size	Income		Size	Income	
		C	E		C	E		C	E		C	E
Washington	3.09	11567	11567	2.82	14151	13808	2.72	17538	17136	2.65	22872	21995
Oregon	3.04	10227	10227	2.79	12462	12276	2.70	15719	15660	2.65	20900	20405
Idaho	3.28	9398	9398	2.92	11064	11680	2.65	13290	14045	2.60	17797	18460
Pacific Northwest	3.09	10909	10909	2.82	13256	13163	2.71	16514	16367	2.65	21752	21294

b. Energy for Residential Appliances. In this case, the basic methodology was to calculate the consumption for each type of appliance in the region or state and then to add results for all appliances. The consumption for appliance of type i is given by

$$A_i(t) = A_i^o \; N_H(t) S_i(t)$$

where $A_i(t)$ - consumption by appliances of type i in year t

A_i^o = consumption per appliance of type i

$N_H(t)$ = household number in year t

$S_i(t)$ = fraction of households having appliance i (saturation ratio)

The expressions for A_i^o are not time dependent. Sensitivity studies indicated that this dependence would not make much difference except for space heating, and there did not appear to be any strong reason for expecting a trend in home heating per home. The saturation ratios $S_i(t)$ were assumed to have the form $S_i(t) = 1 - a_i e^{bi(t-1960)}$ for all electrical appliances except televisions, where $2 - a_{tv}e^{b_{tv}(t-1960)}$ was used. The values of a_i and b_i were found by fitting saturation ratios reported in Merchandising Week. The values of a_i and b_i found in this way are tabulated below in Table III-2.

Table III-2

Values of a_i and b_i for Electrical Appliances

Appliance	Region					
	Washington		Oregon		Idaho	
	a_i	b_i	a_i	b_i	a_i	b_i
Cooking	0.147	-.0529	0.143	-.0459	0.117	-.0410
Space Heating	0.88	-.0229	0.86	-.0205	0.97	-.0015
Water heating	0.172	-.0072	0.207	-.0181	0.1604	-.0026
Clothes washer	0.245	-.0599	0.149	-.0838	0.163	-.183
Clothes dryer	0.619	-.049	0.621	-.0458	0.573	-.0443
Dish washer	0.874	-.0266	1.1364	-.0567	1.068	-.0175
Freezer	0.737	-.0265	0.709	-.0240	0.612	-.0333
Television	1.272	-.047	1.295	-.046	1.583	-.077
Air Conditioner	0.957	-.0034	0.955	-.0123	0.949	-.0132
Lighting	0.0	------	0.0	------	0.0	------
Refrigerator	0.0	------	0.0	------	0.0	------

In the case of space heating, the saturation ratio for fuel oil space heating was not projected using the function $1 - ae^{b(t-1960)}$. Instead, it was assumed that no homes built after 1971 used oil heat. Furthermore, it was assumed that only 82% of the oil heated homes standing in 1971 will still be standing in 1980. Similarly, only 80% of the oil heated homes in 1980 will still be standing in 1990, and only 78% of those standing in 1990 will still remain in 2000.

The saturation ratio for gas heated homes was found from

$$S_g = 1 - S_e - S_o - S_m$$

where S_g = saturation ratio for gas heat

S_e = saturation ratio for electric heat

S_o = saturation ratio for oil heat

S_m = saturation ratio for the sum of coal and LP gas, usually very small or negligible.

The saturation ratio for gas water heaters was found from

$$S_g = S_g(1971) + S_e(1971) - S_e.$$

The base residential forecasts separated by state, appliances, fuels, and year are given in Tables III-3 through III-26. The summaries of contributions to household consumption appear in Tables III-123 through III-130.

Manufacturing. The projections of energy demand for the manufacturing sectors are to a large extent based on the growth in output of the industries. For all manufacturing sectors except lumber and wood products and pulp and paper, the energy per dollar of output (constant dollars) is assumed to remain constant between 1971 and 2000. For the two forest products sectors mentioned above, the assumption was made that growth in output beyond 1980 will require 30% more energy per dollar of output than was needed in 1971. In the calculations done here, "OBERS" earnings were used as a proxy for output. The annual energy consumed by a sector during year t was found from $C_i(t) = \frac{E_i(t)}{E_i(1971)} \times C_i(1971)$, where $C_i(t)$ is the energy consumed per year by sector i in year t, and $E_i(t)$ is the annual earnings in year t for sector C. It should be noted that the evaluation of $C_i(t)$ requires knowledge only of the ratio $\frac{E_i(t)}{E_i(1971)}$ and not of the separate quantities $E_i(t)$ and $E_i(1971)$. Therefore, any quantity proportioned to $E_i(t)$ can be used. For example, for a sector that is not separately projected by OBERS, the earnings for a broader sector containing it can be used as the best available index of its growth. The formula is assumed to apply for each fuel and for electricity.

For SIC classification 32 (stone, clay and glass), there being no independent OBERS earnings projections, the earnings for "Other Manufacturing" was used as the earning index. The earnings for the three primary metal categories, iron and steel, non-ferrous metals, and aluminum are not separately projected in OBERS. Therefore, the earnings for the primary metals as a whole projected by OBERS was used as the index of earnings for all three categories of primary metals.

For the state of Idaho only, as no OBERS projection is available for Paper and Allied Products, the earnings figures for "Other Manufacturing" was used for projection.

OBERS "C" and "E" earnings figure for Aerospace for the State of Washington for the base year 1971 are significantly different. Therefore, for Aerospace in the state of Washington, different reference earnings figures for 1971 were used for projecting Series "C" and "E" respectively.

Adjusted Series C and E for Lumber and Wood and Pulp and Paper. The limitations of raw material availability for the lumber and wood and pulp and paper industries in the Pacific Northwest is expected to limit the growth of these industries beyond 1970. OBERS projections do not account for this limitation. The growth beyond 1970 is therefore adjusted to reflect the raw material limitations.

The growth rates used are (percent per year):

	1970-80	1980-90	1990-2000
Lumber and wood	1	1	1
Pulp and paper	2	1	1

It is also assumed that all additional capacities added to lumber and wood as well as pulp and paper industries after 1980 will require 30% more purchased energy due to increased use of inferior raw materials, anti-pollution requirements, and automation. Hog fuel and combustible liquors from wood processing are not included in these projections. Sectors specified in this report are tabulated in an appendix.

The forecasts based on the procedure outlined above are shown, sector by sector, in Tables III-27 through III-74. Summaries of these results appear in Tables III-123 through III-130. In the Summary tables, the numbers shown in parentheses do not include the adjustments for lumber and wood and pulp and paper mentioned above. The other numbers do include the adjustments.

A critical assumption of these forecasts is that for most sectors, the energy intensity, measured as BTU expended per dollar of output (constant dollars), does not change with time. This assumption is, of course, dependent on the assumption that energy costs remain constant (constant dollars). To some extent, this conclusion is based on the particular industries of this region and may not be true for the nation as a whole (but see references ( )).

Commercial. For most of the commercial sectors, the forecasting methodology used was the same as for manufacturing, i.e., a constant ratio of energy consumption to output (measured by earnings). However, the energy consumed by sectors based on personal services, i.e., trade, finance, services, and government, should have a close relationship to employment, and the forecasts for these sectors were altered accordingly. Specifically, for these sectors the formula used was

$$C_i(t) = \frac{C_i(1971)}{2}\left(\left[\frac{L_i(t)}{L_i(1971)}\right] + \left[\frac{E_i(t)}{E_i(1971)}\right]\right)$$

where $C_i(t)$ and $E_i(t)$ have been previously defined, and $L_i(t)$ is the employment in sector i in year t. The OBERS earnings figure for the combined sectors Transportation, Communications, and Public Utilities was used for projecting Transportation and Communications separately.

The employment figures for Series E were not given by sector in the OBERS reports. In order to obtain them, the Series C values were reduced in the ratio of Series E to Series C population figures.

The forecasts by sector for commerce are shown in Tables III-75 through III-122, and the summary results are shown in Tables III-123 through III-130.

Extractive. The extractive sectors included are agriculture, forestry, fishing, and mining. The projections of forestry, fishing, and mining were made using the OBERS earnings ratios. The forestry and fishing sectors are combined in the OBERS forecasts, and it is fortunate that earnings rather than output is used as the proxy. The energy used and earnings in forestry are small, but output is large and would distort the combined sector projection if it were used. The projections for agriculture were made using output rather than earnings. Output in agriculture is tabulated by OBERS.

The agricultural sector was treated as a special case so far as electricity consumption is concerned because of the anticipated growth in irrigation pumping ( ). Growth of irrigated land in the Pacific Northwest is projected to be 75,000 acres per year from 1971 distributed among the states as follows: Washington--25,000 acres; Oregon--20,000 acres; Idaho--30,000 acres. Electricity required is taken to be 4,000 kwh/year/acre.

Energy Industries. Energy consumption by the energy industries was calculated from the energy delivered to final consumers in the other sectors. In the case of natural gas, the amount of energy used to pump natural gas to California through the Pacific Gas Transmission pipeline in 1971 was added. However, energy required to increase gas transmission to California in later years was not included.

Specifically, the amount of natural gas measured in BTU consumed by the natural gas industry for each state was calculated to be $E_{gas}(t) = E_{gas}(1971) + .04\Delta G$, where ΔG is the growth from 1971 in natural gas used by final consumers.

The oil (including refinery wastes) used by the oil industry (SIC 29 petroleum and coal products) in the Northwest is taken to be the amount used in 1971 plus the amount required to refine the additional petroleum products used in the region in later years. It is assumed that all additions to refining capacity are located in Washington. If refineries are built in Oregon, there should be a shift in oil industry consumption to account for it. Specifically, the oil used by the oil industry is taken to be

$$E^{W}_{po}(t) = (\Delta W + \Delta O + \Delta I) \times .057 + E^{W}_{po}(1971) \text{ in Washington}$$

where $E^{W}_{po}(t)$ = oil used in Washington by the oil industry in year t

ΔW, ΔO, ΔI = increase in oil consumption over 1971 in Washington, Oregon, and Idaho

$E^{O}_{po}(t)$ = $E^{O}_{po}(1971)$ in Oregon

$E^{I}_{po}(t)$ = $E^{I}_{po}(1971)$ in Idaho

It should be noted that there was some use of natural gas in Washington refineries in 1971 and that the amount is assumed not to grow. Furthermore, the 1971 oil consumption figures include some use in other SIC 29 industries, but they are assumed not to grow significantly.

The consumption of oil by the energy industries for transportation is taken to be proportional to total energy delivered to final consumers.

Electricity actually consumed by the energy industries consists primarily of line losses in the electric utility sector, although there is a small contribution from petroleum refining. However, electric utilities also produce electricity, and the tables are set up to show this production. Electricity produced from fuels is included as a negative contribution to electricity consumption in the energy industries. Thus, the net entry in the energy industries column and electricity row is equal to the actual consumption minus the electricity production from fuels. With this number as the entry, the row sums to the electricity produced from hydro projects and the column sums to energy losses in the energy industries including waste heat in electricity production.

The projection of net electricity consumption in the energy industries is carried out as follows. First, the projected electricity delivered to final consumers is calculated. Then, the line losses are estimated at 10% of this figure. Then, the petroleum refining requirement for electricity is determined from the 1971 value. The next step is to add these three figures in order to find the total amount of electricity which must be produced. From this total, the hydropower resource for the state, which appears in the column "Total From Sources," is subtracted. (The allocation of hydropower to a state is done arbitrarily in this report. The fraction of regional (three state) hydropower assigned to a state is taken to be the same as the fraction of regional deliveries to final consumers that occur in the state. The intricacies of individual utility supplies are not considered.)

The net energy obtained by subtracting the hydro resource from the total electricity required is the electricity that must be produced from fuels. This amount is then subtracted from the sum of line losses and petroleum refinery use and the net, generally negative, is the value tabulated for electricity used by the energy industries.

The fuel energy required to supply the thermally produced electricity is found by dividing the latter by the efficiency of the power plants. This efficiency is taken to be 36%, a mean value between nuclear plants and coal fired plants. This value appears in the combined coal and uranium row in the energy industries column. The power plants will not necessarily be in the states to which the power is assigned.

B. Price Adjusted Energy Projections For Households and Industry

The corrections to take account of price increases were made in this report at the level of aggregation represented by the summary tables, i.e., for the household, commercial, manufacturing, and extractive sectors and for electricity, natural gas, oil (other), oil (transportation), and coal. The price adjusted values for the energy industries were found by starting with the price adjusted deliveries to final consumers and then, using the prescriptions described in the previous section of this report, finding the requirements of the energy industries.

The effects of changing energy prices on consumption were evaluated using price elasticity values which were taken from the literature. The elasticities used were long run values, and the reductions calculated using them would not be expected to be fully reached for many years. Therefore, the correction factors were modified for use in 1980; the square roots of the correction factors were used. For example, if the full correction factor in a given case was .64, the value used for 1980 would be .80.

Of course, it is necessary to project future energy prices before it is possible to calculate the corrected consumption figures. For the Pacific Northwest, these future prices have been projected, and the ranges are given in Table III-147. The figures are all expressed in 1973 dollars. It may seem surprising that the future prices do not show an explicit time dependence. The reason that they are expressed as they are is that it was felt that most price increases have already taken place or will be completed shortly. The sharp rises in oil and natural gas prices that have recently occurred represent most of the change which will take place for these fuels through the rest of this century (in constant dollars). The price of electricity is bound to rise. However, a plot of expected prices versus time showed that the price curve levels out fairly well after a few years, and therefore, the same approach was taken as with gas and oil.

In addition to the price ranges, Table III-147 shows two sets of prices, one for the $7 oil case and the other for the $11 oil case. These two cases show the prices used in the two price adjusted projections in this report.

The elasticities used for the two cases are shown in Table III-148a. The smaller gasoline elasticity was used in the $7 oil case and the larger in the $11 oil case. The long term factors by which the base energy projections should be multiplied in order to obtain the price adjusted figures are shown in Table III-148b for the $7 oil case and the $11 oil case. The correction factors for 1980 are also tabulated.

Table III-147

Future Prices of Energy Products in 1973 Dollars

Energy Source	Customer	Ave. 1971 Prices in 1973 Dollars	Future Price Range (1973 Dollars)	Prices for $7 Oil-Low Response	Prices for $11 Oil-High Response
Gasoline	Retail	$.40/gal.	$.46-.80/gal.	$.46/gal.	$.63/gal.
Fuel Oil	Residential	.22/gal.	.27-.46/gal.	.27/gal.	.37/gal.
	Industrial	.11/gal.	.17-.36/gal.	.17/gal.	.27/gal.
Natural Gas	Residential	1.57/Mcf	2.45-3.20/Mcf	2.45/Mcf	3.20/Mcf
	Commercial	1.24/Mcf	2.14-2.90/Mcf	2.14/Mcf	2.90/Mcf
	Industrial	.48/Mcf	1.45-2.20/Mcf	1.45/Mcf	2.20/Mcf
Electricity	Residential	11 mill/kwh	14-20 mill/kwh	14 mill/kwh	20 mill/kwh
	Commercial	12 mill/kwh	15-20 mill/kwh	15 mill/kwh	20 mill/kwh
	Industrial	5.5 mill/kwh	9-13 mill/kwh	9 mill/kwh	13 mill/kwh

Table III-148a

Long-Run Price Elasticities of Demand for Energy

Consuming Sector	Elasticities[a] by Energy Source			
	Gasoline	Fuel Oil	Natural Gas	Electricity
Households	(-.24 or -.80)			
Commercial	(-.24 or -.80)	(-1.0)	(-1.0)	-1.2
Industrial & Extractive	(-.24 or -.80)	-.5	-.5	-.4

a/Percent change in quantity demanded with a 1-percent change in price to the user.

Type of Energy Used	Household Elasticities with Respect to Prices		
	Natural Gas	Electricity	Fuel Oil
Natural Gas	-2.68	.80	0.43
Electricity	0.81	-1.12	0.10
Fuel Oil	1.50	0.21	-2.10

a/The cross elasticity estimates are derived from national data by Anderson using the indirect method of composing overall coefficients by an aggregation of responses for each energy-using appliance. The own price elasticities also are from Anderson's work but were obtained by the direct method.

Sources: Erikson, et.al. Fossil Fuel Energy D Analysis, D.S.C. 3/73.
K. P. Anderson, Residential Energy Use, NSF 10/73.
Mount, Chapman, and Tyrell, Electricity Demand in the U.S., ORNL, NSF 6/73.

ENERGY GROWTH RATES

The projections shown in this report indicate a continuing growth in the use of energy in the region. The annual rates of growth separated by major consuming sector and by fuel are shown for the Pacific Northwest in Tables III-149 through III-154. It is instructive to consider a decomposition of the growth rates into components in order to identify the "driving forces" responsible for the growth. As a first step in the decomposition, the total use by final consumers of energy of type i in year t, namely $E_i(t)$, will be separated into the contributions from the major sectors, i.e., households, commerce, manufacturing, and extractive industries.

Thus

$$E_i(t) = E_{i,H}(t) + E_{i,C}(t) + E_{i,M}(t) + E_{i,E}(t)$$

where the second subscript identifies the major consuming sector as household, commerce, manufacturing, or extractive.

The growth rate per year can then be written

$$\Delta E_i(t) = \Delta E_{i,H}(t) + \Delta E_{i,C}(t) + \Delta E_{i,M}(t) + \Delta E_{i,E}(t)$$

and the fractional growth rate

$$\frac{\Delta E_i(t)}{E_i(t)} = \frac{E_{i,H}(t)}{E_i(t)} \frac{\Delta E_{i,H}(t)}{E_{i,H}(t)} + \frac{E_{i,C}(t)}{E_i(t)} \frac{\Delta E_{i,C}(t)}{E_{i,C}(t)} + \frac{E_{i,M}(t)}{E_i(t)} \frac{\Delta E_{i,M}(t)}{E_{i,M}(t)} + \frac{E_{i,E}(t)}{E_i(t)} \frac{\Delta E_{i,E}(t)}{E_{i,E}(t)}$$

Table III-148b

Price Adjustment Factors for $7 Oil Low Response and $11 Oil High Response Cases

Sector	Energy Source	Price Adjustment Factor for 1980		Price Adjustment Factor for 1990, 2000	
		$7 Oil	$11 Oil	$7 Oil	$11 Oil
Household	Electricity	1.06	.98	1.12	.96
	Natural Gas	.70	.38	.40	.15
	Petrol. (Other)	1.16	1.32	1.33	1.75
	Petrol. (Transp.)	.99	.84	.97	.69
Commercial	Electricity	.89	.73	.77	.54
	Natural Gas	.79	.66	.58	.43
	Petrol. (Other)	.83	.64	.65	.41
	Petrol. (Transp.)	.99	.84	.97	.69
Industrial	Electricity	.91	.84	.82	.70
	Natural Gas	.79	.69	.58	.47
	Petrol. (Other)	.90	.81	.80	.65
	Petrol. (Transp.)	.99	.84	.97	.69
Extractive	Electricity	.91	.84	.82	.70
	Natural Gas	.79	.69	.58	.47
	Petrol. (Other)	.90	.81	.80	.65
	Petrol. (Transp.)	.99	.84	.97	.69

Table III-149
Projected Energy Growth Rates by Consuming Sector and Source
Series C Population Projection - No Response to Price
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
1971-1980								
Electricity	3.9	5.2	3.5 (4.1)	7.2 (2.5)	0	3.5	---	1.2
Natural gas	4.5	5.1	2.9 (4.1)	---	0	3.7	3.2	3.7
Petrol. (Other)	-3.3	4.3	2.7 (4.6)	1.7	0	0.9	5.4	1.4
Petrol. (Transp.)	3.3	4.1	3.7 (5.2)	1.9	0	3.4	0	3.4
Coal	-20	0	2.2	---	0	-2.2	$\boxed{29}$	$\boxed{24}$
Uranium	---	---	---	---	---	---		
Total	2.3	4.4	3.1 (4.2)	3.2	0	3.0	14	4.5
1980-1990								
Electricity	2.9	3.0	2.5 (2.8)	4.8 (1.8)	0	2.6	---	0
Natural gas	1.4	3.1	2.4 (3.2)	---	0	2.3	1.6	2.2
Petrol. (Other)	-2.3	3.4	2.1 (3.3)	3.5	0	1.5	3.0	1.7
Petrol. (Transp.)	4.1	3.3	1.3 (2.7)	1.6	0	3.6	0	3.1
Coal	0	7.2	0	---	0	2.4	$\boxed{7.0}$	$\boxed{6.9}$
Uranium	---	---	---	---	---	---		
Total	2.8	3.3	2.4 (3.0)	2.9	0	2.7	5.6	3.3
1990-2000								
Electricity	2.3	3.4	2.7 (3.1)	3.0 (1.0)	0	2.5	---	0
Natural gas	0.4	3.4	2.7 (3.5)	---	0	2.3	1.4	2.3
Petrol. (Other)	-2.8	3.7	2.2 (3.6)	1.8	0	2.1	3.4	2.3
Petrol. (Transp.)	4.1	3.6	2.2 (3.6)	1.4	0	3.8	1.2	3.8
Coal	---	0	3.1	---	0	1.9	$\boxed{4.8}$	$\boxed{4.8}$
Uranium	---	---	---	---	---	---		
Total	2.9	3.6	2.6 (3.4)	2.1 (1.4)	0	2.9	4.3	3.2

Table III-150
Projected Energy Growth Rates by Consuming Sector and Source
Series C Population Projection - Low Response to $7 Crude
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
1971-1980								
Electricity	4.6	3.7	2.4 (3.0)	6.2 (1.7)	0	3.1	---	1.2
Natural gas	0.6	2.4	0.3 (1.5)	---	0	0.7	0.5	0.8
Petrol. (Other)	-1.7	2.2	1.6 (3.5)	0	0	0.4	5.0	0.9
Petrol. (Transp.)	3.2	4.0	3.7 (5.2)	2.7	---	3.3	-2.5	3.2
Coal	-18	0	2.2	---	0	-2.0	27	23
Uranium	---	---	---	---	---	---		
Total	2.1	3.3	1.4 (2.5)	2.3 (1.1)	0	2.1	12.5	3.6
1980-1990								
Electricity	3.8	1.7	1.5 (1.8)	3.6 (0.7)	0	2.1	---	0
Natural gas	-4.1	0.2	-0.8 (.05)	---	0	-1.4	-0.9	-1.3
Petrol. (Other)	-0.8	1.0	0.8 (2.0)	2.9	0	0.3	2.7	0.7
Petrol. (Transp.)	3.9	3.1	1.3 (2.2)	1.7	---	3.5	2.2	3.5
Coal	0	6.9	2.4	---	0	2.4	6.6	6.4
Uranium	---	---	---	---	---	---		
Total	2.5	2.1	0.5 (1.2)	2.5 (1.8)	0	1.8	5.2	2.5
1990-2000								
Electricity	2.3	3.4	2.7 (3.1)	3.1 (0.6)	0	2.4	---	0
Natural gas	0.4	3.4	2.7 (3.5)	---	0	2.5	0.9	2.4
Petrol. (Other)	-2.8	3.7	2.3 (3.6)	2.2	0	1.4	3.3	1.8
Petrol. (Transp.)	4.1	3.7	2.2 (3.7)	1.5	---	3.8	3.4	3.8
Coal	0	0	3.1	---	0	2.3	5.1	5.1
Uranium	---	---	---	---	---	---		
Total	3.0	3.6	2.6 (3.4)	2.1 (1.4)	0	2.9	4.6	3.3

Table III-151
Projected Energy Growth Rates by Consuming Sector and Source
Series C Population Projection - High Response to $11 Crude
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
1971-1980								
Electricity	3.7	1.8	1.5 (2.1)	5.1 (0.9)	0	2.2	---	1.2
Natural gas	-6.3	0.5	-1.2 (0.1)	---	0	-2.1	-1.0	-1.8
Petrol. (Other)	-0.3	-0.7	0.2 (2.2)	0	0	-0.3	3.5	0.2
Petrol. (Transp.)	1.4	2.1	1.0 (2.9)	-0.3	0	1.5	-2.5	1.4
Coal	-18	0	2.2	---	0	-2.0	$\boxed{22}$	$\boxed{18}$
Uranium	---	---	---	---	---	---		
Total	0.6	1.1	0.1 (1.3)	1.1 (-0.4)	0	0.6	9.4	1.9
1980-1990								
Electricity	2.6	0	0.6 (1.0)	3.5 (0)	0	1.3	---	0
Natural gas	-7.4	-1.2	-1.4 (-0.7)	---	0	-2.3	-1.0	-2.2
Petrol. (Other)	0.5	-1.1	0.2 (1.1)	1.5	0	-.03	1.0	0.1
Petrol. (Transp.)	2.1	1.4	-0.1 (0.7)	0	---	1.7	0	1.7
Coal	0	6.9	2.4	---	0	2.4	$\boxed{5.4}$	$\boxed{5.3}$
Uranium	---	---	---	---	---	---		
Total	1.5	0.4	-0.2 (0.5)	1.9 (0.5)	0	0.7	3.6	1.3
1990-2000								
Electricity	2.3	3.2	2.7 (3.2)	2.6 (0)	0	2.3	---	0
Natural gas	0.5	3.5	2.6 (3.5)	---	0	2.6	1.0	2.5
Petrol. (Other)	-2.8	3.7	2.1 (3.7)	1.3	0	0.6	3.1	1.0
Petrol. (Transp.)	4.1	3.7	3.4 (4.1)	1.3	0	3.8	4.1	3.8
Coal	---	0	3.1	---	0	1.9	$\boxed{6.3}$	$\boxed{6.0}$
Uranium	---	---	---	---	---	---		
Total	2.6	3.6	2.6 (3.3)	1.3 (1.0)	0	2.7	5.3	3.2

Table III-152
Projected Energy Growth Rates by Consuming Sector and Source
Series E Population Projection - No Response to Price
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
1971-1980								
Electricity	3.1	4.2	2.8 (3.3)	8.0	0	2.9	---	1.2
Natural gas	3.4	4.6	2.5 (3.6)	---	0	3.1	1.8	3.1
Petrol. (Other)	-3.5	3.7	2.5 (4.2)	0	0	0.6	4.8	1.1
Petrol. (Transp.)	2.6	3.5	2.2 (5.2)	1.6	---	2.8	0	2.8
Coal	-7.7	0	1.2	---	0	-1.3	26	22
Uranium	---	---	---	---	---	---		
Total	1.7	3.8	2.6 (3.6)	3.1 (1.5)	0	2.4	12	3.8
1980-1990								
Electricity	2.2	2.4	2.0 (2.4)	4.1 (1.3)	0	2.0	---	0
Natural gas	0.3	2.3	2.0 (2.7)	---	0	1.6	0.7	1.6
Petrol. (Other)	-2.2	2.8	1.5 (2.8)	1.5	0	1.0	2.5	1.2
Petrol. (Transp.)	3.6	2.8	2.2 (2.9)	0.9	0	3.1	3.4	3.1
Coal	0	0	1.0	---	0	0.6	6.2	6.1
Uranium	---	---	---	---	---	---		
Total	2.2	2.6	1.9 (2.6)	2.1 (1.0)	0	2.2	4.9	2.7
1990-2000								
Electricity	1.8	2.6	2.2 (2.4)	2.9 (0.6)	0	2.0	---	0
Natural gas	0.3	2.7	2.2 (2.6)	---	0	1.9	1.3	1.8
Petrol. (Other)	-2.7	2.8	2.2 (2.8)	0	0	1.5	2.7	1.7
Petrol. (Transp.)	3.2	2.9	2.4 (2.6)	1.1	0	3.0	1.3	2.9
Coal	-4.0	6.9	3.1	---	0	2.1	4.4	4.4
Uranium	---	---	---	---	---	---		
Total	2.2	2.8	2.2 (2.6)	1.8 (0.9)	0	2.3	3.8	2.6

Table III-153
Projected Energy Growth Rates by Consuming Sector and Source
Series E Population Projection - Low Response to $7 Crude
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
71-1980								
lectricity	3.8	3.0	1.7 (2.3)	6.7 (0.8)	0	2.5	---	1.2
tural gas	-0.6	2.0	-0.1 (1.0)	---	0	0.1	0	0.2
trol. (Other)	-1.8	1.7	1.5 (3.1)	0	0	0.1	4.6	0.7
trol. (Transp.)	2.5	3.7	2.3 (4.4)	1.5	0	2.9	-2.5	2.8
al	-7.7	0	+1.2	---	0	-1.3	24	20
anium	---	---	---	---	---	---		
tal	1.5	2.9	0.9 (1.9)	2.8 (1.3)	0	1.7	10.7	2.9
80-1990								
lectricity	2.7	1.0	1.0 (1.3)	2.8 (0)	0	1.6	---	0
tural gas	-5.4	1.8	-0.1 (-0.4)	---	0	-1.9	-0.9	-1.8
trol. (Other)	-0.7	0.4	0.1 (1.7)	0	0	-0.9	2.0	0.2
trol. (Transp.)	3.4	2.2	2.2 (3.1)	0.7	0	2.8	0	2.8
al	0	0	1.0	---	0	0.6	5.7	5.5
anium	---	---	---	---	---	---		
tal	2.0	1.3	0 (0.7)	1.3 (0.5)	0	1.2	4.1	1.8
90-2000								
lectricity	1.8	2.6	2.2 (2.4)	3.0 (0.7)	0	1.9	---	0
tural gas	0.5	2.7	2.2 (2.7)	---	0	2.0	0.9	1.9
trol. (Other)	-2.7	2.7	2.2 (2.8)	0	0	0.8	2.4	1.1
trol. (Transp.)	3.2	2.8	2.4 (2.7)	1.0	0	3.0	4.0	3.0
al	-4.1	6.9	3.1	---	0	2.1	4.8	4.7
anium	---	---	---	---	---	---		
tal	2.2	2.8	2.2 (2.6)	1.7 (0.9)	0	2.2	4.1	2.6

Table III-154
Projected Energy Growth Rates by Consuming Sector and Source
Series E Population Projection - High Response to $11 Crude
(Annual Per Cent)
Pacific Northwest

Source of Energy	Households	Commercial	Industrial	Extractive	Other & Unaccounted	Total to Consumers	Energy Industries	Total From Sources
1971-1980								
Electricity	2.9	0.7	0.9 (1.4)	5.1 (0)	0	1.6	---	1.2
Natural gas	-7.4	0	-1.6 (-0.5)	---	0	-2.6	-1.0	-2.4
Petrol. (Other)	-0.4	-1.3	0.2 (1.9)	0	0	-0.5	3.0	-0.1
Petrol. (Transp.)	0.6	1.5	2.0 (5.2)	-0.3	---	0.9	-2.5	-0.8
Coal	-7.7	0	+1.2	---	0	-1.3	18	15
Uranium	---	---	---	---	---	---		
Total	.05	0.5	-0.3 (0.8)	1.1 (-0.2)	0	0.1	7.0	1.1
1980-1990								
Electricity	1.9	-0.6	0.2 (0.6)	3.1 (-0.9)	0	0.8	---	0
Natural gas	-8.5	-2.2	-1.7 (-1.2)	---	0	-2.7	-1.5	-2.6
Petrol. (Other)	0.6	-1.7	-0.8 (0.5)	-4.1	0	-0.4	0.6	-0.1
Petrol. (Transp.)	1.6	0.7	-1.8 (-1.3)	-1.5	---	1.1	0	1.1
Coal	0	0	0.9	---	0	0.6	4.4	4.1
Uranium	---	---	---	---	---	---		
Total	1.1	-0.3	-0.7 (-0.2)	0 (-1.6)	0	0.2	2.7	0.6
1990-2000								
Electricity	1.8	2.5	2.1 (2.3)	2.9 (0.9)	0	1.9	---	0
Natural gas	0	3.1	2.1 (2.6)	---	0	2.2	1.5	2.1
Petrol. (Other)	-2.6	2.8	2.4 (2.9)	0	0	0.2	2.2	2.1
Petrol. (Transp.)	3.2	2.9	2.6 (2.5)	0.9	---	3.0	2.2	3.0
Coal	-4.1	6.9	3.1	---	0	2.1	6.4	6.4
Uranium	---	---	---	---	---	---		
Total	1.9	2.9	2.2 (2.6)	1.6 (0.8)	0	2.1	5.0	2.6

In this way the fractional growth rate for each energy type, for example, the overall electricity growth rate, can be built up from the contributions from the four major consuming sectors. In the remainder of this section of the report, this type of analysis will be made for electricity, natural gas, and oil for the Pacific Northwest as a whole in the base case, i.e., no price response, and for the Series E population projections.

Electricity. The electricity consumption by households is the product of the number of households and the average consumption per household, i.e.,

$$E_{elect,\,H}(t) = N_H \sum_j S_{elect,\,j}(t)\, E_{elect,\,j}$$

where $E_{elect,\,H}(t)$ is the electricity consumed by households in year t

N_H is the number of households

$S_{elect,\,j}(t)$ is the fraction of households having appliance j in year t

$E_{elect,\,j}$ is the average annual electricity consumption by appliance j

From this

$$\frac{\Delta E_{elect,\,H}}{E_{elect,\,H}} = \frac{\Delta N_H}{N_H} + \sum_j \frac{E_{elect,\,H,\,j}}{E_{elect,\,H}} \frac{\Delta S_{elect,\,j}}{S_{elect,\,j}}$$

Table III-155 shows the annual values of $\frac{E_{elect,\,H,\,j}}{E_{elect,\,H}} \frac{\Delta S_{elect,\,j}}{S_{elect,\,j}}$ for 1960, 1970, 1980, 1990, and 2000, for the household appliances included in the household electricity forecasts.

Table III-155

Values of $\frac{E_{elect,\ H,\ j}}{E_{elect,\ H}} \frac{\Delta S_{elect,\ j}}{S_{elect,\ j}}$ For One Year Interval

Appliance	Year				
	1960	1970	1980	1990	2000
Cooking	.0010	.0006	.0002	.0002	.0001
Space Heating	.0312	.0183	.0126	.0090	.0069
Water Heating	.0005	.0004	.0003	.0002	.0002
Clothes Washer	.0001	.0001	.0000	.0000	.0001
Clothes Dryer	.0003	.0014	.0007	.0004	.0002
Dish Washer	.0008	.0005	.0003	.0002	.0001
Freezer	.0022	.0013	.0008	.0005	.0004
Television	.0020	.0012	.0005	.0002	.0001
Air Conditioner	.0011	.0007	.0005	.0005	.0005
Lighting	0	0	0	0	0
Refrigerator	0	0	0	0	0
Total	.0392	.0245	.0159	.0112	.0085

Table III-156 shows the average annual value of $\frac{\Delta N_H}{N_H}$ in the decades 1960-1970, 1971-1980, 1980-1990, 1990-2000. Combining these two components produces the average household electricity growth rates shown in Table III-157. These

Table III-156

Average Annual Fractional Change in Number of Households, Series E

Time Period	Average Value of $\frac{\Delta N_H}{N_H}$
1960-1970	.020
1971-1980	.013
1980-1990	.010
1990-2000	.009

tables show a decline in the percentage growth rate of household electricity consumption because of the saturation of electric appliances It should be pointed out that changes in annual consumption per appliance were not included,

Table III-157

Average Annual Household Electricity Growth Rates for Base Case, Series E

Time Period	Average Annual Growth Rate
1960-1970	5.9%
1971-1980	3.1%
1980-1990	2.2%
1990-2000	1.8%

but these effects should not be large. The application of the same formulae used to make the 1980, 1990 and 2000 forecasts were applied to 1960 as a check. The total consumption indicated by the formulae was 54 x 10^{12} BTU for the Pacific Northwest, whereas the actual was 53 x 10^{12} BTU.

These calculations do not include major new technological developments, which could increase or decrease consumption. For example, the introduction of an electric automobile could make a large upward revision to the estimates, whereas the widespread adoption of heat pumps would greatly reduce them.

The price increases considered in this report are expected to produce an additional shift away from residential use of natural gas. This shift will raise the percentage growth rate of electricity and/or oil during the period when the adjustment is taking place, but after the adjustment period is over, the percentage growth rates will not be altered. For the higher set of prices and elasticity values, called $11 Oil-High Responses, the total growth rates for electricity are expected to be slightly depressed, as shown in Table III-158. For the lower set of prices, the household electricity consumption is increased.

Table III-158

Effect of Price Increases on Household Electricity Growth, Series E

Time Period	Average Annual Growth Without Price Increases	Effect of Price Increases	Total Annual Growth Including Price Increases for $11 Oil Case
1960-1970	5.9%		
1971-1980	3.1%	-0.2%	2.9%
1980-1990	2.2%	-0.3%	1.9%
1990-2000	1.8%	0	1.8%

The electricity consumption in manufacturing and commercial businesses was forecast sector by sector in this report. However, the qualitative estimates of growth presented here are made in an aggregated form in order to relate the growth to parameters describing production. The decomposition of the overall growth is done by writing the consumption

$$Q = \frac{Q}{O} \times \frac{O}{S} \times \frac{S}{L} \times \frac{L}{P} \times P$$

where Q = energy consumed per year

O = output per year

S = earnings (OBERS) per year

L = number of workers

P = population

The percentage growth rate in Q can be written as the sum of the percentage growth rates of the separate ratios/ i.e.,

$$\delta Q/Q = \delta\left(\frac{Q}{O}\right)\Big/\frac{Q}{O} + \delta\left(\frac{O}{S}\right)\Big/\frac{O}{S} + \ldots + \delta P/P$$

The forecasts in this report are made assuming that the amount of energy of each type used per unit of output of each sector measured in constant dollars does not change with time (with a few exceptions previously noted). Thus, it is assumed that the energy efficiency is constant and that there are no interfuel substitutions. There is some evidence on a national basis for the assumption of constant energy per unit of output. Schurr et. al. ( ) and National Economic Research Associates ( ) show a downward trend in BTU per unit of gross national product extending from 1870 to 1966 and a small increase since then. This coefficient is not the same as BTU per unit of output, but the two are closely related. At any rate, this assumption is made in this report for all sectors except lumber and wood products, pulp and paper, and agriculture. With the assumptions used to make the base forecast in this report, large substitutions (in industry) of electricity for other fuels would not be expected. Electricity was assumed to remain inexpensive in the base forecast, but natural gas, coal, and oil were even cheaper. Under the new conditions of higher prices and limited availability there will be a sharp reduction in the future use of natural gas. However, it is doubtful that electricity will be substituted by industry in most cases because of the lower cost of oil and coal. Oil should be available from Alaska and Indonesia and coal from the Rocky Mountain states. In the aggregated formulation here presented, differences in the growth of energy intensive sectors relative to others would appear as a change in the aggregated quantity $\frac{Q}{O}$. The effects of such changes on the overall electricity growth rate are shown in Table III-159. The quantity $\frac{O}{S}$ is assumed to be constant in time, which means that the relative importance of capital and labor in business is not changing. The historical record supports this conclusion.

Now consider the other ratios which are responsible for the growth shown in the base forecast in this report. The projected population growth rate, Series E, is shown in Table III-159. The table also shows growth in the number of persons employed per capita as a result of the changing age distribution and the increasing entry of women into the job market. The fourth column in the table shows the growth in earnings per employee. Entries in columns 2, 3, and 4 are based on the Series E OBERS projections. Column 6 is the electricity growth rate in the combined manufacturing and commercial sectors, and column 5 is the difference between column 6 and the sum of columns 2, 3, and 4. The numbers in column 5 represent the shifts in the ratio $\frac{Q}{0}$, or more accurately $\frac{Q}{S}$ that arise because of the differences between the growth rates of energy intensive sectors and the growth rates of other sectors. In particular, the negative numbers in column 5 reflect primarily the smaller growth rate forecast for aluminum reduction in the Pacific Northwest in the future. Incidentally, the tabulations in column 6 use the unmodified OBERS forecasts, for which the results are shown in parentheses in the summary tables.

Table III-159
Annual Growth Rates Affecting Pacific Northwest Electricity Consumption In Commercial and Manufacturing Sectors - Series E

Time Period	Population	$\frac{\text{Employment}}{\text{Population}}$	$\frac{\text{Earnings}}{\text{Employee}}$	$\frac{\text{Electricity Used}}{\text{Earnings}}$	Electricity Consumption (Base Case)
1971-1980	0.6%	1.0%	2.1%	-0.1%	3.6%
1980-1990	0.7%	0.1%	2.4%	-0.8%	2.4%
1990-2000	0.5%	0.0%	2.8%	-0.9%	2.4%

Price increases will reduce the rate of growth of electricity in manufacturing and commerce. The more severe of the two price responsive cases, that is, the $11 oil - high response case, gave the results shown in Table III-160. The effects of increased price should be less than this table indicates at least in 1980 because the electricity price increases up to the present time (1975) have not been as large as this case assumes.

Table III-160

Effects of Price Increases on Commercial and
Industrial Electricity Consumption
$11 Oil - High Response Case, Series E

Time Period	Electricity Growth Rate Base Case	Change in Growth Produced by Price Increases	Electricity Growth Rate, Price Responsive
1971-1980	3.6%	-2.5%	1.1%
1980-1990	2.4%	-2.1%	0.3%
1990-2000	2.4%	0.0%	2.4%

Electricity consumption in the extractive sector is dominated by irrigation pumping. The forecast is based on a constant rate of bringing new land under irrigation at a constant electricity requirement per acre of land irrigated (4000 kwh/acre). The results are converted to an annual percentage growth rate with and without price increases in Table III-161. The table shows a very rapid growth rate in electricity use in agriculture up until 1980 and then a gradual tapering off in the percentage later in the century.

Table III-161

Growth Rate of Electricity Consumption in Extractive Industries
Base Case and $11 Oil - High Response, Series E

Time Period	Growth Rate Base Case	Growth Rate $11 Oil - High Response
1971-1980	8.0%	5.1%
1980-1990	4.1%	3.1%
1990-2000	2.9%	2.9%

Natural Gas. The household consumption of natural gas is not subject to the simple analysis carried out for electricity. The number of gas heated homes is calculated as the difference between the total number of occupied homes and the number heated by electricity, oil, or coal. In the base case, where price increases and scarcity are not included, household consumption of natural gas is calculated to continue to grow through the rest of the century. The growth rate tapers off, however, as household electric heat takes an increasing share of the market.

The anticipated sharp increases in natural gas prices are expected to greatly reduce the household consumption of natural gas compared to the amount predicted in the base case. This trend is consistent with the uncertain availability of natural gas in the future. The sets of prices and elasticities that were used predict a shift to electricity and oil, particularly to oil in the $11 oil case. For reference, the growth rates for household use of natural gas in the base case and the $11 oil - high response case are shown in Table III-162. The growth in the commercial and industrial sectors can be analyzed in the same fashion as was done for electricity. The results are shown in Table III-163 (using the unadjusted industrial output values shown in parentheses in the summary tables). The entries in column 5, derived by subtracting column 3 from column 5, show that the industries that are heavy users of natural gas, especially the pulp and paper industry, grow less rapidly than other industries in the region after 1980. This effect is further accentuated by the adjustments to output made for the forest products industries.

Table III-162

Annual Growth Rates for Household Use of Natural Gas in the PNW
Series E

Time Period	Annual Growth Rate Base Case	Annual Growth Rate $11 Oil - High Response
1971-1980	3.4%	-7.4%
1980-1990	0.3%	-8.5%
1990-2000	0.3%	0.3%

Table III-163

Annual Growth Rates Affecting Pacific Northwest Natural Gas Consumption
In Commercial and Manufacturing Sectors, Series E

Time Period	Population	Employment / Population	Earnings / Employee	Natural Gas Used / Earnings	Natural Gas Consumption (Base Case)
1971-1980	0.6%	1.0%	2.1%	0.1%	3.8%
1980-1990	0.7%	0.1%	2.4%	-0.6%	2.6%
1990-2000	0.5%	0.0%	2.8%	-0.6%	2.7%

The effects of price increases on natural gas growth rates are shown below in Table III-164. The tables show the strong effects of price increases on natural gas consumption in commerce and industry.

Table III-164

Growth Rate of Natural Gas Consumption In Commercial and Manufacturing Industries For Base Case and $11 Oil - High Response

Time Period	Growth Rate Base Case	Growth Rate $11 Oil - High Response
1971-1980	3.8%	-0.4%
1980-1990	2.6%	-1.3%
1990-2000	2.7%	2.7%

Oil. Household Consumption of oil consists of two parts. One is fuel oil used for space heating. The other is gasoline used for automobile transportation. In the base case, the consumption of fuel oil for heating is projected to decline because of the gradual replacement of oil heated homes by new homes heated either by gas or electricity. The rate of replacement is estimated to be 2.2% per year until 1990 and then 2.6% during the period 1990-2000. These percentages also represent the rates of decline of household fuel oil use between 1980 and 2000 according to the assumption made in this report that the average use per household is constant in time. The decline during the period 1971-1980 is more rapid because of a second assumption that oil fueled hot water heaters and L-P space heaters are converted to other fuels.

The growth in household gasoline use is determined in the forecasts made in this report almost entirely by the growth in personal income in the region. The growth rates are shown in Table III-165. Price increases can be expected to alter the household consumption of fuel oil and gasoline. The particular set of prices and elasticities used in this report for the $11 oil - high response case produces a sharp shift toward oil heating and away from natural

Table III-165

Annual Growth in Household Use of Fuel Oil
In the Pacific Northwest - Series E

Time Period	Annual Growth Base Case	Change In Growth Rate Produced by Price Increases $11 Oil-High Response	Annual Growth $11 Oil-High Response
1971-1980	-3.5%	+3.1%	- .4%
1980-1990	-2.2%	+1.6%	.6%
1990-2000	-2.6%	0.0%	-2.6%

gas compared to the base case with no price changes. Electricity is not greatly affected. However, the shifts are sensitive to the parameters used in the calculation, and a lowering of the electricity price relative to oil will produce a shift toward electric heating at the expense of oil. In any case, a decline in natural gas consumption is expected. The effects of price increases on household fuel oil consumption are shown in Table III-165. Price increases will depress the rate of growth of gasoline consumption as well. Table III-166 shows these results according to the elasticity used in this report.

The growth of oil consumption in commercial and manufacturing industries is shown in Table III-167 in the same format as was previously used for electricity and natural gas. The table shows that for oil as for electricity and natural gas, the growth of energy intensive industries is less rapid than the growth of other industries. The effect of price increases on the growth rate is shown in Table III-168.

The growth of oil consumption in the extractive sector comes primarily from the growth of agriculture. The analysis that was used for commercial and manufacturing industries will not be used in this case; but the growth rates in the base and $11 oil - high response cases are given in Table III-169.

Table III-166

Annual Growth in Household Use of Gasoline
In the Pacific Northwest - Series E

Time Period	Annual Growth Base Case	Change in Growth Rate Produced by Price Increases $11 Oil-High Response	Annual Growth $11 Oil-High Response
1971-1980	2.6%	-1.9%	0.6%
1980-1990	3.6%	-1.9%	1.6%
1990-2000	3.2%	0.0%	3.2%

Table III-167

Annual Growth Rates Affecting Pacific Northwest Oil Consumption
In Commercial and Manufacturing Sectors, Series E

Time Period	Population	Employment / Population	Earnings / Employee	Oil Consumption / Earnings	Oil Consumption Base Case
1971-1980	0.6%	1.0%	2.1%	0.0%	3.7%
1980-1990	0.7%	0.1%	2.4%	-0.4%	2.8%
1990-2000	0.5%	0.0%	2.8%	-0.5%	2.8%

Table III-168

Growth Rate of Oil Consumption
In Commercial and Manufacturing Industries
For Base Case and $11 Oil - High Response - Series E

Time Period	Growth Rate Base Case	Growth Rate $11 Oil - High Response
1971-1980	3.7%	1.0%
1980-1990	2.8%	0.6%
1990-2000	2.8%	2.8%

Table III-169

Growth Rate of Oil Consumption in Extractive Industries
For Base Case and $11 Oil - High Response, Series E

Time Period	Growth Rate Base Case	Growth Rate $11 Oil - High Response
1971-1980	1.6%	-0.3%
1980-2990	.9%	-1.5%
1990-2000	1.1%	1.1%

Coal. Deliveries of coal to final consumers was not considered in the projections except for home heating. Consumption of coal in the commercial, manufacturing, and extractive sectors was carried along at 1971 levels. The use of coal for electricity generation is included, however. It seems reasonable to believe that coal could be substituted for oil in regional industries if oil becomes unavailable or much more expensive before the end of the century. The coal could be used in solid form or could be liquified or gasified.

EXAMINATION OF WILLIAM A. BREWER

Cross, by Applicants

By Mr. Bellingham:

Q Now, Mr. Brewer, let's start off on page 2, if we might, of your written statement. At line 16 you are quoting Hubbert once again, and you state that he correctly identified the inevitable cycles of depletion of the fossil fuels, and correctly identified the bases for the energy crisis which became prominent less than two years later. Now, first of all, I have trouble with the language used there; less than two years later from the fifteen years that you refer to Hubbert, or is it two years later than 1971. I assume it's the latter; is that right?

A That is correct.

Q Now when we talk about fossil fuels, we are including what fuels in that category?

A Hubbert addressed himself primarily to petroleum and natural gas, but he also identified a longer cycle for the depletion of coal resources of the world.

Q And that's what I wanted to bring up, of course. When we talk about the depletion of the fossil fuels, we know, for example, that oil and gas,we have real problems with them; don't we?

A In Hubbert's view, we have real problems with all fossil fuels.

Q Now what about coal?

A Hubbert's view, which has been widely substantiated by others, and certainly the geological fact is that no new fossil fuels are being deposited in the crust of the earth, and while the depletion cycle for coal is longer, on the order of a few hundred years rather than perhaps a hundred or hundred and fifty years in the case of petroleum, the fact is that we are not making any more, and eventually all fossil fuels will be depleted if we continue our present rate of consumption.

Q Now what is your analysis of the future of coal insofar as longevity is concerned?

A Well, it depends entirely on the extraction rate, but the range of depletion of coal in the United States, for example, would be on the order of several hundred years; it could be as short as three hundred or as long as five hundred.

Q Yes, and five hundred years has been a figure widely used, has it not?

A It has been used by some.

Q You have no quarrel with the five hundred year figure, I assume?

A I would say that if you want to provide me with a rate of extraction consumption and a reserve figure, it's relatively easy to calculate what the cycle is going to be.

Q Well, I don't think we need to go into that at this time, but my original question was whether or not you agree that perhaps five hundred years is a reasonable figure?

A It's not an unreasonable figure.

Q Now then on page 2, line 19, and here again you are quoting Hubbert; he predicted that during the forthcoming period of stability -- what do you mean by the forthcoming period of stability?

A The period of stability that Hubbert subscribes to and I also do,means that there will be a tapering off of the consumption, the rate of growth in consumption of all energy resources of a non-renewable character, that energy growth rates are declining in the United States and worldwide for the non-renewable resources.

Q This has been true for the last how long a period?

A In the United States, and I assume that's what you're interested in, the tapering off has begun largely in the late 1960's.

Q Now then I think you'd subscribe to the theory that you cannot correctly load forecast based upon the experience of a year or two, can you?

A One or two years? No, I think that would be insufficient.

Q Right. So when you load forecast, you need to look at the picture as an entirety, isn't that right, as a whole?

A Not necessarily. If you look at the picture as a whole, that means that you're looking at an historic period of time, and my thesis, which I think is brought out in this testimony, is that you have to break that up into segments and you have to look at the root causes. There have been a number of changes in the period of time, or the whole, that we are looking at here.

Q Yes, I'm aware of that, but get back to the amount of time involved. Certainly, as you've indicated, a year or two is not enough of a period in longevity to accurately forecast from; is it?

A The answer would depend on your knowledge and understanding of the root causes of any change that took place in a year or two. I assume that you're interested in the electrical load situation in the Pacific Northwest.

Q That's right.

A I would say that one year is insufficient unless you have perfect knowledge of the causes that took place in one year.

Q God didn't endow anybody with perfect knowledge of anything, did he, when it comes to economics?

A That's a question of a philosophical nature which I'm not competent to answer.

Q Well, I think you've philosophized quite a bit in here, Mr. Brewer.

MR. SHERIDAN: I object; move to strike counsel's statements.

HEARINGS EXAMINER: They will be striken.

Q To go back to the time period, I think it's generally assumed, and I gather from the comment made by you, that a year or two is pretty insufficient upon which to establish a load forecast?

A Going to the heart of the matter, my analysis is not based on one or two years.

Q All right, fine, but would you answer my question, please; one or two years is not sufficient, is it?

A In my view, one or two years is not sufficient.

Q Fine. That's what I was trying to find out, and I appreciate your answer, fine. Now regardless of the type of forecasting, we still have to use history as a guide; isn't that right?

A That is a thesis which is popular, certainly to my knowledge, among some of the applicant companies. If you want me to give you a specific straight answer on that, you'll have to give me a more direct question; which period of history, for example.

Q Well, no load forecasting is going to be done without looking at historical trends, is it, as one of the components to go into that forecast?

A I do not subscribe to that statement.

Q Do you believe that you can correctly forecast loads in the future without looking at the past?

A It depends on the method of forecasting that you use. You certainly have to have historical data for a sectoral forecast such as the type I subscribe to, and the more historical data you have the better the quality of your information. However, a forecast based solely on the extrapolation of historic trends, I believe, is going to be erroneous in this situation for the future.

Q All right, now let's get back to my question, and I didn't imply, and I think it's clear in my question that I didn't imply that you had used historical trends only. I am saying that historical trends are not to be ruled out as a component of any load forecasting, is it?

A No, sir; I am not trying to be contentious. I would say, and I strongly believe this, that the historical trend is not a component of anything; the historical trend is the sum of components, and a sectoral forecast divides the situation into those components, examines them parameterically and the result is the trend, whether it's historic or a new departure.

Q Well, in the use of your forecasting, and we'll get into that later that you term sectoral, you do rely then upon historical trends, do you not?

A I rely upon historical data. I repeat that the trend is the sum of the components.

Q All right. We are playing with words here, I think; but let's use your language then, that's fine. So you do rely upon historical data?

A That is correct.

Q You have to crank that into your computations?

A Certainly; this is how you find out how people and industries behave.

Q Now to go back to page 2 again, you indicate there, line 22, you refer to wholly new technologies will permit the utilization by society of traditional as well as exotic energy resources and so forth. Now what exotic energy resources are you referring to there?

A One of the first to appear on the scene will be the adaption of solar energy, and I don't mean necessarily the direct capture of energy from the sun, but the use of bioconversion techniques; for example, to capture and fix solar energy. Following that will be nuclear fusion; we have every expectation this will happen. There are developments in magnetohydrodynamics, MHD, which may provide for more efficient energy conversion. These are what I would term exotic techniques.

Q You've mentioned now solar, nuclear fusion, MHD, any others?

A It is quite possible that we will use energy conversion and storage devices which obtain their energy from traditional sources, but which make energy available in ways that we are not accustomed to. I think that there is an entire spectrum of technology from source to conversion to storage to utilization which is not at present in widespread use, but whose physical principles are quite well understood and which will become quite important by the turn of the century.

Q By the turn of the century; you're talking about the year 2000?

A I said by the turn of the century.

Q Well, let's go back here. What are your predictions as far as solar heating and cooling are concerned?

A In what parts of the world or the country?

Q Well, we're talking about the United States, I think.

A The United States. I would expect that by 1985 we will have probably one or two percent of our total energy needs being met by direct solar processes.

Q By 1985. Now, then, what about nuclear fusion?

A The technology of nuclear fusion, in my opinion, at its present state of development, does not permit you to make an engineering or economic analysis of when it will be widely available. It is a gamble which we are undertaking on a national level with rather substantial public investment with the expectation, as supported by expert opinions, that fusion technology will be at or close to the practical state perhaps within a technical generation.

Q Within what?

A A technical generation.

Q Now what is a technical generation?

A A technical generation is comparable to a human generation in that a parent gives birth to a child; it often corresponds to a twenty year period. It might be ten years in a rapidly moving technology; it might be thirty in another case.

Q So you would put it on a basis of ten to thirty years, isn't that right?

A Someplace in that range, yes.

Q You don't really anticipate that we are going to have any industrial development of nuclear fusion as far as generation of electricity within the next few years, do you?

A A few years? Five or six?

Q Right.

A At an economic industrial level? I do not anticipate it.

Q What about moving up the line, what about by 1985; rather remote I would gather?

A It's conceivable.

Q Conceivable? On a small scale would you say?

A That's speculative.

Q Fine. Well, that is right. I think you've hit a good word there, didn't you, speculative?

A That's a word which I and many others have used. Certainly it is speculative in 1976.

Q Fine. Now I would like to ask you one further question on solar. Now you mentioned solar heating, one or two percent possibility by '85; isn't that right?

A Yes, sir.

Q And you confine your remarks, as I recall, to solar heating. Am I right in that?

A I think by in 1985 the primary applications will be in direct capture of solar energy for heating of space and media.

Q And when you say one or two percent, you're talking about one or two percent of what?

A United States energy consumption.

Q Energy consumption?

A Yes, sir.

Q Not confined to electrical consumption?

A Not confined to electrical consumption.

Q And you're putting it on the basis of heating alone; isn't that right?

A Yes, sir, on the basis that this is a technology which requires zero technical breakthrough to implement today.

Q Now we're not talking about the generation of electrical power in the context which you have used as far as applied to solar?

A In 1985 it is entirely feasible, in my opinion, from the engineering standpoint, to generate substantial amounts of electrical power through the direct conversion of solar energy. The question in my mind is one of the comparative economics. It may be more attractive economically in 1985 to use traditional methods, but again there is no technical breakthrough required to be generating electricity from solar means in 1985.

Q Well, I take it that by 1985, when you use the word economic, you're talking about cost figures, and at this stage of the game, it is very unlikely that in 1985, from an economic standpoint, solar will be used to any extent as far as generation of electricity?

A It depends on the cost, mills per kilowatt hour, of the available supplies of electrical energy from other sources, and the total demand for electrical energy in all forms.

Q And I would guess then we can use the word speculative again when we move into this field; isn't that right?

A I think the cost of electricity from other sources, the conventional sources, in 1985 is speculative today.

Q And that applies also to the cost of solar to be used for generation purposes?

A Perhaps less so than in the case of traditional generation.

Q All right. What about MHD; so that there will be no question upon the record, we're talking about magnetohydrodynamics, are we not?

A Yes, MHD is, for practical purposes, simply an attempt to improve the thermal efficiency of the conversion of traditional fuels into electrical energy which is, I'm sure you are well aware, at a rather distressingly low rate today.

Q Well, what do you foresee as far as time periods are concerned for MHD?

A MHD, I would consider, a parallel technology. In other words, we may want to abandon MHD as a technology for the conversion of energy if we have any better alternatives. Right now there are problems associated with confinement of a plasma, for example, which say that MHD is not a leading technology, one which is extremely attractive for, say a utility or an engineering firm to go into compared to even conventional nuclear generation.

Q Well, it's in its infancy, isn't it, basically?

A It's a young technology.

Q And you are aware, of course, of the Butte development regarding MHD, are you not?

A I am aware that there is a development; I'm not familiar with the details of it.

Q It's in the infancy stages there and, of course, it's going to take years. Looking down the road, hopefully, maybe MHD might be a solution, or a partial solution, perhaps maybe I should more appropriately phrase it, in the period subsequent say to 1990 or so; does that make sense?

A It's a possibility.

Q A possibility. You wouldn't put it as far as you're concerned prior to that time, would you?

A I would hesitate to speculate as to when that particular technology may become a viable alternative.

Q It's down the road anyway, isn't it?

A It's down the road.

Q And again the word speculative is a pretty good word to apply to it, to MHD?

A Is that a question, sir?

Q Yes.

A Of course, it's speculative.

Q Now other technologies. I think originally when we started this questioning, you referred to other technologies in a broad way. Can we be more definitive now as to what?

A Yes, sir; I would like to expand upon that. I believe there is one whole field of technology which has been very badly neglected by both the producers and the consumers of energy in the United States; and I refer to the technology of energy conservation. You may be aware that other countries today with higher or comparable standards of living, higher or comparable per capita incomes, very similar methods of operating in industry, manufacturing, commerce and residential use, get by with 2/3 or 60 percent or 55 percent of the energy used per capita or per unit of output than we do today, West Germany being a prime example. It is simply not necessary to waste energy in all its forms the way we do in this country to maintain our standards of economic output and living. Now the technology of energy conservation is, in most cases, not exotic technology. It simply means the replacement of inefficient equipment with up to date equipment, catalog items off the shelf, if you will. It means systems engineering, the energy conversion process as a whole; for example, the recovery of waste heat from conventional coal or oil fired power plants where that heat can be used at modest temperature in other processes, such as the curing of resident plywood, food processing, or even space heating. You cannot call these exotic technologies, but they're very important technologies. The amount of money that can be saved, and the amount of energy in BTU's that can be saved is tremendous. It's staggering when one looks at the potential, and I believe that this is the prime technology that this country and all of the components of our economy must concentrate on now in order to avoid the disasters of high cost and unavailability of our fossil fuel resources.

Q Well, this is a subject that has attracted a lot of attention, has it not, from economists, engineers?

A Yes, it is attracting a growing amount of attention.

Q And there has been repeated references in this testimony to it. I'm not sure that we need to go into detail into it insofar as what your beliefs are on it. We are aware of what has happened in the past upon a voluntary basis as far as conservation is concerned; it started off well and it dropped off, did it not?

A Nobody has ever been able to identify since the 1973 energy crunch the amount of conservation which has been done for voluntary or ethical reasons as compared to the amount which has been done for sound economic reasons. In many parts of our economy, energy was simply too cheap to conserve before energy prices started rising; and as I am sure you are aware, it is largely in the industrial sector that the sharpest increases in energy prices have taken place as compared, for example, to the residential sector. Now it's my belief that you can find a sound explanation for energy conservation that has taken place in the economy through economic principles, as I've attempted to bring out in my testimony to this board. It simply pays now for a company, or a utility for that matter, to pay strict attention to the cost of the formerly cheap energy and to use that efficiently in all of their processes.

Q Mr. Goldhammer has testified previously in this case; I'm sure you know who he is?

A I know Mr. Goldhammer.

Q And he indicated that in the Pacific Northwest the saving was approximately 5 percent over a period of a year or so during and immediately after the energy crunch back in 1973, and that since then conservation savings has dropped alarmingly and that it is a real problem today insofar as getting people to voluntary conserve. I assume you have no quarrel with that particular approach, do you?

A I have a problem with that particular number; I was very very close to the energy conservation efforts, the electrical energy conservation efforts, in the northwest in the year 1973, which had nothing to do with the Arab embargo. It was one of the lowest water periods on record in the northwest. Now at that time I was working very closely with the northwest Governors, Governor Evans and McCall in particular, and we had almost daily measurement of consumption and the effectiveness of the appeals for voluntary conservation of electrical energy. I would like to state to the record that for periods of two and three weeks, we were pushing 10 percent, strictly on voluntary conservation, and I say strictly on voluntary because there was no time available to adopt the longer lasting means of electrical energy conservation that we have since seen. Since that time, I have been very close to many northwest industries in particular who have made permanent savings in energy consumption, what you would call economically induced conservation, on the order of 5, 10 and even 15 percent in some industries. So I don't know what a 5 percent figure introduced by Mr. Goldhammer refers to unless it could be perhaps a 5 percent drop below projected demand for that period. That, I believe, is about right, 5 percent below trend, if you will, or 5 percent below forecast.

Q Well, we've discussed voluntary conservation; do you see in the future that we're going to have to go into involuntary conservation?

A It is quite conceivable that we could have involuntary or mandatory conservation for certain forms of energy and over certain periods of time. Certainly another Arab embargo today while we are importing six million barrels of oil today would be cause for involuntary or mandatory conservation at the national level.

Q Now turning to page 3 -- oh, before we do that, you talk about conservation as another possibility as far as the future is concerned in the context that we were talking about nuclear fusion, solar and so forth. Are there any other so-called exotic energy resources that you can think of off hand at this time?

A There are technologies which would come under the heading of exotic, such as ocean thermal energy conversion, or the application of wind power, which, in my view, are a rather limited or specialized nature. I believe the ones I've given you represent my opinion of the leading alternative technologies.

Q And then we can classify the others as most speculative and down the road as far as possibilities are concerned.

A There is nothing speculative about a windmill; it's an entirely developed technology. All we have to do to find out how to make this effective is look into the past and apply a little bit of aeronautical engineering. When I say limited or of a specialized nature, I refer to the competitive economic applications.

Q And insofar as time frame is concerned, what are we looking at here?

A Windmills? I see quite a few windmills in this area; that's today. Ocean thermal energy conversion? Straight-forward application of thermaldynamic principles, perhaps available in 10 to 12 years.

Q You mentioned windmills; I think most of us that grew up in this area during the depression remember windmills out in the hills, and sometimes you could even burn a couple of 75 watt bulbs, as we previously testified to in this case. However, its application on a commercial basis at this time is certainly not practical when you compare it to alternatives, is it?

A I share your memory, Mr. Bellingham. Being on a farm in the depression years, we pumped water with wind power until we got on REA. It was much cheaper to use that low cost electrical power for pumping and more reliable. It was an economic decision on the part of my family and many others; it was probably an economic decision on the part of your family.

Q Well, you don't foresee any breakthroughs insofar as the application of wind to commercial technology within the immediate future, do you?

A Not to generating significant amounts of utility grade electrical power, no; if that's the thrust of your question, I would confirm that that is, in my opinion, not a viable alternative for utility grade electrical power.

Q All right, turning now to page 3, line 9, "As a matter of fact and, increasingly, as a matter of record, real economic improvement in this country requires that energy growth rates be sharply reduced relative to the recent past." Now you state here that real economic improvement requires that energy growth rates be reduced. What do you mean?

A This will take a somewhat lengthy reply, but it's a key point in my testimony. If you look at the history of energy costs, energy in all forms in the United States, going back say to the 1920's, you can develop a trend of real costs per unit of energy which was in almost every case declining through the mid 1960's. What I'm saying is that for an economic enterprise which used energy, labor, land, and other resources to create a useful product, the amount of money that had to be spent on energy constantly declined until about the mid 1960's. At that point, it went almost flat; the cost in real dollars, current dollars, for several years remained the same. Now since about 1968 or '69, in the case of northwest electrical energy, the cost has been increasing. That means if you want to make a ton of aluminum, or 10,000 square feet of plywood, or something like that, the amount of money that has to be devoted to purchasing energy increases. And this is true not just of the northwest industries, but of all industries in this country. If we cannot control the growth in energy consumption, then we cannot control the price of the energy that we buy on a unit basis, which means that we will have to put more and more of our capital into purchasing energy for these goods and services and there will be less and less for the other sectors of the economy which are important. This, in my view, is the situation which requires that we curb energy growth and, particularly, energy growth rates in terms of economic and social factors.

Q Let's talk about the gross national product for a second here. What do we mean by gross national product?

A Gross national product is ordinarily defined as the total value of goods and services produced by an economy, or unit of analysis, over a period of time.

Q Now then are you familiar with, and have you ever studied it at all, the growth of energy in this country and its relationship to the growth of the gross national product?

A Yes, sir, I have studied and I have read other studies of energy consumption versus growth in the output of goods and services, and I'm quite familiar with the lockstep theory.

Q And it is true, is it not, that they have always paralleled each other as far as growth is concerned?

A Parallel means lockstep, I suppose, in the context here. No, I do not agree that they have been in absolute lockstep. Both have been rising, but so have other factors, too, the number of automobiles on the road. We are in a constantly growing and expanding society as well as a growing and expanding economy.

Q Well, it is true, is it not, that as the gross national product has risen, so also has the use, or should I say consumption of electricity and other forms of energy?

A That is a perfectly correct statement; they have risen over the same period of time.

Q And they have risen not exactly in the same proportions or rates, but fairly close to each other, have they not?

A Fairly close to a casual analysis; that's a true statement.

Q And there have been a lot of studies done regarding this to show this result, isn't that right?

A Perhaps too many.

Q Well, what is the future in the event that energy growth suddenly tapered off?

A What is the future?

Q Yes.

A You mean what are the characteristics of the future?

Q You would like to see that happen, of course?

A I would like to see it happen because I believe it would be a net benefit not only to the society, but even to the energy producers.

Q Well, let's move one step further. Say that we had a shortage of electricity; what would happen?

A We will have a shortage of electricity someplace, sometime; I believe that's inevitable for quite some time to come. What will happen is pretty much a matter of record. We will have a requirement for some period of cutback, curtailment, conservation, or even allocation. During that period, there will be a direct effect on certain sectors of the economy. For example, in the area with which I am most familiar, the Pacific Northwest, there will be a recall by Bonneville and by those utilities which have written interruptable supply contracts with major industrial consumers, there will be a recall of the interruptable portion, just as is taking place with natural gas today. When those shortages are reduced or eliminated, as they will be, there will be a resumption of that interruptable supply.

Q Now I think you made the statement you foresee a shortage of electricity in the future?

A I cannot tell you when and where it is going to happen; what I'm saying is that in an electrical system largely dependent upon either the hydro base that we now have in the northwest, or upon less reliable thermal systems, there will be times when either system outages or water shortages will provide less energy than the total of all demands in all sectors under all contractual arrangements.

Q Now insofar as the shortage is concerned, you refer so blithely to it, can you put any kind of a time frame on it?

A It's very difficult to do that in a system which is still largely hydro based because that means that you have perfected weather forecasting, and this we cannot do.

Q Well, you mentioned hydro based. I gather that you are confining your remarks at this particular time to the northwest area; is that right?

A I could give you my opinion of what will happen in other electrical reliability councils around the country, but I do not have the firsthand knowledge that I do for the northwest.

Q When you say shortage of electricity, are you confining that to the northwest, or are you saying that that's going to happen to the nation as a whole; I presume the latter?

A There will be spot shortages in other areas I'm quite certain. For example, in the southwest, which I would consider mostly central and southern California and Arizona, you are aware, of course, that we have exchange agreements between the northwest and the southwest, and at certain periods, particularly the summer peak there, it's quite essential for the maintenance of those high consuming, fast growing areas that they be able to get energy from the northwest. If in a bad water year, we are unable to supply it, there will be shortages in Arizona or California.

Q So that what you're saying is that as far as the nation as a whole is concerned, you foresee spot shortages?

A I do, indeed.

Q Now as far as the time is concerned, I realize you cannot put an exact time frame on it, but can you give us what your best opinion is as to when this is going to start developing?

A Are you talking about the United States as a whole or the northwest?

Q Yes, sir, the United States.

A I would have to consult references to make any sort of a reasonable estimate, references particularly the Federal Power Commission sources to review the situation in electrical reliability councils with which I am not directly familiar.

Q So as far as the nation is concerned, you don't have the facts and figures at hand now to make an educated guess?

A Not here today.

Q Now let's confine ourselves next, and move to the Pacific Northwest. As far as time frame, energy shortages in the future are concerned, what do you foresee there?

A Beginning with the present, I would say that because we are some 2,000 megawatts below projected consumption in the latest West Group Forecast, the regional forecast, that we are in probably very good shape for at least the near term, the near term being two or three years. The rate of growth in electrical demand in the Pacific Northwest has undergone a remarkable flattening in the last few years, and it's a trend which goes back really to 1968 and 1969. So it would take a somewhat unusual or unforeseen circumstance to greatly increase the rate of growth in demand in the Pacific Northwest over the next few years, something that we don't know about in any of the utility systems. Now the shortage, of course, is based upon demand versus the total available resources; but I think the fact that we are in the process of increasing our reserve percentages, the fact that Bonneville has provided a greater proportion of interruptable, or recallable, power to its very very significant direct service industrial customers means that we have more of a cushion now than we did say in 1972 or '73, which were years of scarcity for some industrial consumers. Therefore, I would say that for the next few years, we are in pretty good shape.

Q Now you use the word near term?

A Which I defined as a few years.

Q Yes, and you also mentioned two or three years; this is the time frame of your thinking?

A Yes, beginning my response to your question, I said for the beginning now and for the next few years, it looks like we're in pretty good shape.

Q And can we limit that say to the next two or three years as you have previously?

A No, that could very easily become a longer lasting situation, in my view, if we do not pick up load and, in particular, if we proceed with the plans now underway for installing additional peaking capacity in the mainstem Columbia and other components of the northwest hydro system.

Q Now let's move from short term into, what shall we call it, long term?

A Define the long term and I'll attempt to respond.

Q Well, I'd assume that you did as far as this particular discussion is concerned. Now you define the near term within the next few years, and I gather that you've indicated two or three years, a possibility of more. Well, let's extend it beyond three years. I gather from your analysis that there is a possibility after three years that we can have a energy shortage in the Pacific Northwest?

A If we pick up loads of a certain type. A shortage can be created by adding load to the system.

Q And so by the time that 1979 or '80 rolls around, there is a possibility that we can have an energy shortage?

A There's always a possibility. Even by 1980 the hydro component will still be a very large component; and a very bad year, such as 1973, could create a shortage in some sectors.

Q Now then as far as this period down the road is concerned, this, of course, is going to depend upon demand as you have indicated. So I take it to summarize your thoughts upon this subject, within the next few years, say up to two or three years, perhaps another year or so, you don't expect to see any real problem; but for the term beyond that, there is a possibility, a distinct possibility perhaps I should say, that we could have an energy shortage in the Pacific Northwest?

A I would prefer to summarize for myself on that, but I'm in general agreement with what you've said. There is a possibility, and if we add enough load, it could become a distinct possibility of spot shortages.

Q Fine. Now then I think I used the words energy shortage. Were you thinking in terms of energy, or were you thinking in terms of electricity?

A I have used energy in my testimony. I have attempted to use it in the technical sense as average energy rather than peak demand. Now electricity is not a technical term in this context. We can talk about energy and peak if you'd like, or we can talk about power and energy.

Q Well, I was thinking in terms of a comparison of electricity as compared with all forms of energy. Now were you confining your remarks to electricity; is that my understanding?

A No, sir, in my testimony, as originally submitted, I made a rather comprehensive, developed a rather comprehensive relationship between electricity and other forms of energy, traditional forms, which are available.

Q Well, leaving out what you indicated in your study here, and confining ourselves to the remarks that you have made within the last five minutes while on the witness stand, were you thinking in terms of all forms of energy, or were you thinking in terms of electricity alone?

A I think it's naive to look at electrical energy demands and supplies without looking at the other traditional sources, oil, natural gas, coal, hog fuel, and the other media that we use. In every case I attempt to relate my remarks on energy, my conjecture about the future to a quantified conjecture about the availability of alternative energy forms. For example, in my testimony I talk about growth and eventual maximum saturation rates of electrical space heating in the northwest; I speak of an economic penalty for electric space heating; that's here today. The reason that exists is because you have a pretty fair conjecture about what it's going to cost to heat with gas and oil in the future; it's simply cheaper. People follow economic laws, and I say that in quotation marks; they do not blindly rush to the most expensive form of space heating. They'll buy what looks like the best bargain, and I believe that has a fairly significant effect on the growth of electrical energy demand.

Q Well, then as far as your remarks are concerned, you're talking about energy as a whole; is that right?

A It depends on the question you asked me. Mr. Bellingham.

Q Well, I'm talking about what you --

A I try to think in terms of total energy.

Q All right, fine. And if we confine our remarks only to electricity, as far as the periods of time that you have previously testified to, I assume your answer would be pretty much the same; is that right?

A I'm sorry I don't follow the question, my answer to what, sir?

Q Well, we have discussed here time frames in the future, near term, long term, and so forth, within the last five minutes or so?

A Going over the questions that we have exchanged here, no, I would say my remarks on electricity do not apply to other energy forms. For example, I do not foresee any shortage of crude oil in the Pacific Northwest or in Pad 5, Petroleum Allocation for Defense District number 5, which is roughly the west coast states. Quite to the contrary, other work that I have performed indicates that there will be a surplus of crude oil and refining capacity in this area at least through the 1980's.

Q Well, others might disagree with your approach on that; isn't that right?

A It's possible to disagree with anybody. My work has been done in conjunction with the Federal Energy Administration, regions 9 and 10, Stanford Research Institute, agencies in the states of California, Oregon, Washington, Alaska, and the province of British Columbia, and I believe that there is a convergence of opinion, for example, over this oil situation. But it is perfectly possible to disagree with this.

Q Well, now let's go back here to your analysis here that you made awhile ago, remember the near term and the long term, and I'd like it established as to just exactly what forms of energy you were applying your remarks and answers to; and I take it that you were talking about energy as a whole; is that right?

A In every question that you have asked me I have attempted to talk about either electricity in the national area or electricity in the Pacific Northwest or total energy, depending on the question that you've asked me. I certainly would resist any generalization of my response to a question which I believe was aimed at the electrical area into the total energy picture.

Q So then I can assume then that when we talked about the possibility of shortages around 1980 or so, which you addressed yourself here to a short time ago, that your remarks were limited to what, energy as a whole, or electricity?

A My remarks about a possible spot shortage in the Pacific Northwest in the period around 1980 was confined to electrical energy. If you want to broaden that to the total energy picture, I've already given you a response on petroleum. I could give you another estimate as far as natural gas goes, but we'd have to discuss the unknowns and imponderables of today's natural gas situation. Certainly there will be shortages for some uses of the cheapest fuel at any given time. This is, I believe, quite easily derived from economic principles. Gas is your cheapest fuel today; it will always be in short supply.

Q Now then let's move off this subject and get back to your written testimony, if we might. Page 3 again, line 25, you talk about we finally turned the corner in energy consumption in the year '74. What do you mean by that phrase?

A Turning the corner in this case means that for the first time over a period of many years, and this is going back say to depression years, we used less energy in a given year than we did in the previous year, on a national basis, total energy.

Q I see. Now when we talk about turning the corner, let's go back in history. We had problems as far as the economic structure of the country is concerned in the 1930's, did we not?

A We certainly did.

Q And energy consumption went down at that time, of course?

A Yes, sir.

Q And so I guess we might say that we turned the corner at that time, as you have used the phrase?

A By strict definition, if one could say that we dropped in energy consumption during some periods of the 1930's.

Q And then following that drop, we had an increase in energy sales in this country, did we not, the line moved up?

A We had an increase in energy sales in this country and in the world.

Q And perhaps I should more appropriately call it consumption, so the curve moved up as far as energy consumption is concerned immediately following the early 1930's; isn't that right?

A Yes, sir.

Q And then when was the next period of time that we turned the corner, as you have phrased?

A To my knowledge there was no significant drop in energy consumption from the dark days of 1934-'35, as I remember, of the depression until 1974. However, there were certain anomalies in there. There were economic downturns in the '60's; World War II created an anomalous situation. I am sure you will recall that during the '30's and the '40's the United States, for example, was a major exporter of petroleum. We supplied oil to the entire world, so oil production figures are somewhat distorted by exports during those periods.

Q Well, what about the period of around 1938? We also had a drop at that time, did we not?

A There was a second wave of the depression, or a premature recovery, if you will; and, yes, it is quite possible that there was another drop, net drop, in energy consumption then.

Q I think you'll admit then that we did turn the corner in approximately 1938; is that right?

A By strict definition, certainly. We had a decline in the mid 30's and I'm quite prepared to accept your evaluation that there was another in the second little depression.

Q Fine. Now let's move on up the road, if we might, to more near to the present. Do you recall any other turning of the corner in say the 1940's?

A I do not, sir.

Q Well, if I were to tell you that energy sales around 1945 went down again, would you accept that?

A If you told me that full correction had been made for the reduction in petroleum exports during the war years, if that is part of your analysis, I would be prepared to accept that.

Q Well, I'm going to hand you a chart here, energy sales compiled from reports by Edison Electric Institute, and I think you'll see here a drop in about the 1945 period, do you not?

A Sir, this refers to total electric utility industry sales, and we have been talking about total energy up to this point. The turning the corner that I referred to is total energy. Now I believe we have to have a much more precise definition of what we are talking about here, whether it is total energy or electrical energy sales by utilities.

Q What were you talking about?

A I was under the impression that we were talking about total energy; that's what turning the corner in my testimony referred to.

Q Fine, I don't think there is any problem with what our understanding is, and I think you indicated that you are willing to accept energy sales went down in the 1945 period?

A Electrical or total?

Q Total.

A That chart, sir, does not indicate that to me. I know that there were some minor corrections economic and otherwise at the end of World War II. That chart refers only to electrical utility sales, total energy in the electrical utility sense. Do you have another exhibit which talks about total energy, energy in all forms?

Q No, I don't now, but moving on up the road, we saw in the 1945 period, experienced a growth period, did we not?

A Undoubtedly.

Q And this moved on up constantly. Do you recall any downward swings as far as electricity sales or total energy sales, insofar as the nation as a whole is concerned, from year to year during this period following 1945?

A Which, total energy or electrical?

Q Both, let's refer to both.

A It is my belief that total energy consumption continued to increase year by year from the end of World War II through the Korean War years up until the turning of the corner that I referred to in my testimony. Now electrical energy use on a national basis, I believe, has continued to increase year by year, although I'm quite certain that in certain utility service areas, or even in regional units of analysis, there may have been declines and increases.

Q But generally speaking, during this period of time, and I think you've indicated it already, the line moved up, did it not?

A I would stipulate in the interest of brevity that during this period of continued physical and economic growth from World War II until the energy crunch of the '70's, both the economic indicators and the total energy consumption and the electrical energy consumption, as a rule, have tended to increase with some parallelism.

Q Now on page 4, line 24, you indicate here that demand forecasting employed by electric utilities in the Pacific Northwest tends to result in artificially high, inflated, estimates out toward the end of the forecast period. What forecast period are you talking about?

A I'm talking about the 10 and 20 year forecast periods of the West Group Forecast, the forecast issued annually by Pacific Northwest Utilities Conference Committee, and specifically I'm referring to the West Group Forecasts beginning in 1968 and running through the 1975 forecast which is the latest available.

Q Well, now is it your opinion that the West Group Forecast extends out over a period in excess of ten years?

A Projections are made without the level of detail for twenty year periods. The detailed forecast is a ten year forecast.

Q Basically they concentrate on ten year forecasts, do they not?

A That is correct, sir.

Q And when you talk about the end of the forecast period, you're talking about the end of say a twenty year period, are you?

A No, in many cases I'm talking about the end of the ten year period, particularly for the forecasts that we're looking at now, the '75 and '74 and '73 forecasts.

Q Right, and that would take it out to the end of say '85, '86, is that right?

A Ten years from the date of the forecast.

Q Now at the top of page 5 you're talking about circumstances which have changed?

A Are you referring to lines 3 and 4?

Q Right, and you're talking here about demand forecasts, isn't that right?

A Yes, sir, I'm talking about the West Group Forecasts.

Q And you talk about circumstances changing; what circumstances are you referring to?

A The largest in terms of volume is the reduction, almost the cessation of letting large new direct service industrial contracts between industries and the Bonneville Power Administration; in particular reference here I would refer to a contract which was first written in 1966 and which has a possibility of being implemented depending on the results of litigation to the present owner of that contract which is Alumax, a consortium of Amax and Mitsui Metals. Now that contract, depending on how the plant comes in in final design could be 200 to 300 megawatts of industrial power. There is another large industrial contract, or contractual arrangment, which has been made between Bonneville, I believe Washington Water Power, and possibly other utilities, but primarily Bonneville

Power to Alcoa Aluminum Company of America for a light metal and magnesium and silicon plant at Addy, Washington. However, that particular arrangement does not require new firm power. The plant operation is based on surplus, or secondary, power which may become available either through allocation of Alcoa's own power contracts, or from Bonneville, or from other utilities in the region. Now beyond that I do not envision, and in many public statements Bonneville leads me to believe that there will be no more of those very large industrial contracts written.

Q Now you have referred in your testimony here about a flattening out of the curve at the present period of time in various places?

A Yes, sir.

Q What is your analysis as far as the reasons for this flattening out are concerned?

A These are several fold. One of the first is that there has been greater saturation of appliance and equipment use in the residential and commerical sectors in the years leading up to 1968-'69 when this flattening began. Then most people, and perhaps most utilities, realized some of the growth in these sectors, residential and commercial, and I'm talking here about the smaller commercial units which act very much like households, added electrical space heating, electrical clothes dryers, electrical water heat, during the period of the 1969's, which as you will recall, was one of almost universally heavy promotion by both public and private utilities. This was the era of the gold medallion home, heavy promotion to the consumers. Now you can develop over a period of several years what appears to be a growth trend in this area, but you cannot sustain it forever because most houses only have one water heater, or at most two, and they can only take so many showers and wash so many clothes. The same applies to space heat, electric tooth brushes, any other electrical consuming appliance that you want to deal with. You reach a point of saturation, and I believe during the late '60's we were filling up a demand that was created for various reasons which displaced other forms of energy or created new needs and new wants on the parts of the consumers. Now since that time, particularly for the years 1971 and '72, my colleagues and I have done quite a bit of analysis of saturation and distribution of these electricity consuming devices in homes, and my conclusion is that we are approaching saturation in many of these areas. Secondly, during this period, the second cause, going back to your question, obviously there was a great deal of promotion, if you will, or simply marketing, marketing is a perferable term, of available, that is unused, unsold, electrical energy to industrial, manufacturing, and large commercial users. This was an era, particularly in the state of Washington, the major industrial state in the northwest, of rather rapid growth perhaps keynoted by the aerospace industry in Washington which is not a large electricity user in terms of output, but many people were coming, many industries were established. Some of these were electricity intensive, and they filled up a big piece of the available power. Finally, toward the end of this period, natural gas became available more widely in the northwest. Natural gas is a very late comer in the Pacific Northwest. It was sold rather cheaply here. It will never be as cheap again; it will never be even very reasonable again, but during this period, this kind of took the top off electrical growth in the late '60's. So these are some of the causes of this flattening.

Q Well, you have omitted one cause that seems to be advanced by a lot of people, and that is the recession that we've had in the last short period of time?

A I'm glad you raised that question. In one of my exhibits here, I have attempted to compare the economy of the state of Washington with that of the nation as a whole, and with electrical growth rates which are about the same in Oregon and Washington which dominate the Pacific Northwest figures. The state of Washington, and to some extent the state of Oregon, have done a little better than the nation as a whole in terms of ordinary economic indicators while still going through a remarkable flattening in electrical load growth. I believe this is the point where the lockstep has been broken, and I believe that for the various causes that we've discused here, it's not really very pertinent to use historical data from 1938 or 1945 or earlier periods as indicators of the future. And as a matter of fact, various students and analysts of the past recession have shown that even though we had, for example, a remarkable decline in the Dow Jones Index, the value of common stock, on a lumped basis, and while we had a remarkable increase in unemployment during this period, when you look into the type of recession it is and how we have managed it, we've handled this very differently from past periods. For example, while we may have 8 and 9 percent unemployment figures at the national level, the unemployment for male heads of households the last time I looked in a national publication was running around 4 percent. It's a different sort of recession is what I'm saying, and it has tended to de-couple from the energy picture. And as a second point, and I think this is a critical one in this discussion, the tapering off of electrical load growth in the northwest began well before the current recession; and in my view it began in 1969. Now that was a period not only of normal growth in most of the northwest, it was pretty good times.

Q Well, let's get back to the recession again. There is one and there has been one going on in the nation as a whole, has there not, in the last couple of years?

A For the last couple of years? Yes, sir.

Q And we still are not out of the woods?

A Compared to what? Normal?

Q Normal.

A Normal increase in the economic indicators?

Q Right, yes.

A No, we are below the normal rates of increase, historic rates of increase, in the economic indicators.

Q And this is also applicable to the Pacific Northwest as well as the nation as a whole, is it not?

A To a somewhat lesser extent.

Q But it's still present?

A There has certainly been an economic downturn in the Pacific Northwest economic indicators as a whole.

Q Right. Now as far as the future is concerned, when do you think we are going to be out of it?

A I don't mind speculating on this, but I will stipulate that I am neither an economist nor a seer; I think probably during the coming year we will be back to relatively normal times in the northwest in certain areas. However, you must realize that the economy of the Pacific Northwest is not the national economy; it's quite different. It's, in many ways, a resource dependent economy, and if wheat goes from $4.65 to $1.75, we can have a recession or depression all of our own. The same applies to forest products, aerospace, and the other kingpins of our rather simple and specialized economy.

Q Well, as far as the Pacific Northwest is concerned, I know you've indicated that you think that perhaps the next year will see us out of the present one?

A This is simply a personal opinion, Mr. Bellingham.

Q Right, we understand that; that's what I've asked you for is your personal opinion.

A It is not related to my analysis for this case, nor to my professional expertise.

Q What about the nation as a whole?

A I could not speculate on that.

Q Would you say perhaps the same time frame as the Pacific Northwest?

A Perhaps later, but again this is simply a citizen opinion, not related to this case or my expertise.

Q Well, you talk in here about different methods needed for forecasting, isn't that right?

A That is correct, sir.

Q And I assume that this is based upon certain things that have happened within the last few years, the elasticity, cross-elasticity, conservation, and so forth; am I right on that?

A Yes, sir, in part.

Q And you feel that a new approach is needed?

A Yes, sir, I feel that very strongly.

Q Yes, and you have, along with others I guess, have set up what you call a sectoral forecast?

A Along with others, that is correct.

Q And who are these others?

A In the case of Exhibit 115, the others are Professor George Hinman of Washington State University, Professor Walter Butcher of Washington State University, their colleagues and graduate students, who have been performing these analyses and projections and, in some cases, sectoral forecasts for a period of about three years now, perhaps three and a half years, under federally funded programs generally described as guidelines for a northwest energy policy, and sponsored by the Pacific Northwest Regional Commission of Vancouver, Washington. Now this is a body of data which is extremely large and far-ranging, and during this period, the emphases have been on data collection as well as methodology. In addition, work which I originated and which was published in January of this year, relates energy use and economic output and it's summarized in a publication called Energy Input-Output Model for the State of Washington, published by the University of Washington, which is a classic energy overlay to the Laoptiov (?) type of input-output economic model.

Q Then as far as your steps regarding sectoral forecasting is concerned, who heads this team? Anybody in particular?

A I head one team at the present through the Energy Research Center of the State of Washington which is an agency created this summer for regents of the University of Washington and Washington State University which encompasses the six state supported institutions of higher learning in our state.

Q Now I take it that your collaborators on this project, or the people that you've mentioned, are mainly college people and their students and graduate students and so forth; is that right?

A No, sir, that is not correct. I have to go back to the history of the Energy Policy Council in the state of Washington which was created by executive order of Governor Evans in early 1972. At that time, a group of citizens, I would not call it strictly a citizen group, but a group of citizens agreed to serve voluntarily under the leadership of Governor Evans to develop both a basis of information and some policy guidelines for the state of Washington. Now this group included at the end of its work, which was in January of 1975, over 90 knowledgeable, informed people in the state of Washington, including representatives of the university community, Professors Butcher and Hinman in particular, also Professor James Crutchfield, an economist from the University of Washington who was chairman. But it also included people from the utility industry; for example, the presidents of two of the applicant companies here. It included representatives of environmental groups; for example, the president of the Washington Environmental Council, the general manager of the Washington public power supply system, the northwest manager for Kaiser Aluminum, people from manufacturing, from financial institutions, president of a large bank, and people who were in or had been in state government including elected representatives.

Q Well, now these people that you mentioned they helped, I assume, in supplying data and background material; is that right?

A Yes, sir, particularly in the area of industrial consumption and utility figures.

Q But insofar as actually setting up this type of forecast, I take it that this was confined to a few people, the actual mechanics after the data had been gathered?

A The task force, which is a subcommitte of the Energy Policy Council, which developed a very elementary forecast for the council, as I recollect had about 12 to 15 members out of a total membership of 90. So I guess you could say that it was a few.

Q Now are you familiar with Kent Anderson?

A Yes, sir, I know him.

Q Of the National Economic Research Association?

A Yes, associates.

Q Associates. Are you familiar with his work as far as forecasting is concerned?

A Yes, sir; I've sited some of Dr. Anderson's work in my testimony. We have, for example, used his estimates of elasticity and cross-elasticity where applicable.

Q And he has also developed a similar type of forecasting system; is that right? Are you aware of that?

A Yes, sir; I was present when Dr. Anderson was testifying to the Thermal Power Plant Site Evaluation Council of the state of Washington earlier this year in relation to electrical load growth in our area, in which he said that he had analyzed the data and he predicted a load growth rate for the state of Washington between 3 and 6 percent annually.

Q I believe your thesis here is that traditional methods of forecasting need to be looked at and worked on in the hopes that it can be improved; isn't that basically --

A That's my thesis as well as the thesis of the northwest utilities operating through PNUCC who have employed Dr. Anderson, or at least his firm, to review their methods of forecasting.

Q And it's to the good of the utilities that if changes need to be made in methodology, that they do it?

A I would certainly agree with that; I think it's essential.

Q And utilities themselves are interested in making certain that their forecasts are correct?

A I hope that is the case.

Q Well, there's a reason for it, isn't there, really?

A I can think of a number of good reasons.

Q Would you say that as far as the past techniques are concerned, that utility companies have used methods that have pretty well served them as far as past factors or the past years are concerned?

A To which period of the past are we talking?

Q Well, let's talk about the last twenty years or so.

A In the northwest, up until the last '60's, I would say that the forecasting method very closely served the needs of utilities; and let me expand upon that. During this period, there was unsold capacity. In my view, the forecasting method was a surrogate for a market forecast. In other words, it identified for the utilities the markets that they would be able to capture over the various years in the forecast period; and I would acknowledge that they did an excellent job of filling up demand. In fact, in the year 1968 there was a rather significant increase of demand over the forecast induced, in large part, by a very cold winter and a space heating load, but also by a rapid expansion in the economy. So I would say, yes, over that period, the forecasting method employed by the utilities served their needs very well.

Q Now let's move to your particular forecasting method you call the sectoral method. This is in a state of infancy I could term it, I believe; would you agree with that?

A No, sir, I would not.

Q Well, how would you term it?

A I would identify the sectoral forecast as laid out in Exhibit 115 as a very straight-forward mathematical procedure. You will notice in this exhibit that rather than speculation or trending, we have written mathematical equations which leave no room for error to account for a very large number of sectors in the total demand picture. Now the mathematics here are not in their infancy; they are very standard mathematical techniques. Then into

Q Well, I'm not interested --

A Please let me finish, sir.

Q All right, excuse me; I'm sorry.

A Now once you've written an equation with a number of variables in it, you have to insert values for those variables; and I believe that in this case, which I do not claim to be a perfect sectoral forecast, but I do claim is a complete one, we have inserted actual values. These are both present values obtained from direct survey and historical information which we have obtained from the same sources that all utility forecasters use. Now you insert the variables into the equation, you get an answer. The answer turns out to be total electrical demand, with the appropriate qualifications, for year end. If you want to argue with any part of a sectoral forecast, then you have to come back with another equation or another compilation of variables; and I am hopeful that utilities, or individuals, or organizations who contest this forecast, preliminary one, will come back with their own variables because, in my opinion, this puts the question of future load growth in the public policy area where it belongs. If, for example, we forecast tremendously increased electrical consumption in the forest products industry, which is a possibility, then we know where the load growth is coming from; we can look at growth in the forest products industry for what it is; we can compare it to the available resources, or the materials, labor, land, water, its environmental and socio-economic impacts, and if a public decision can be made that load growth should take place at the proposed rates in the forest products industry, we get on with it. If we have to build another power plant to do that, we build another power plant to do that. What we escape, or what we avoid, through this sectoral process is having unknown causes of load growth buried in a lumped total, and I believe that's the phrase I used in my testimony, and I think that is a very bad practice for the utilities and for the public at large.

Q Do you remember what my question was some time ago?

A Your question was that you proposed to me that the sectoral forecast was in its infancy, and I contested that. I say no, it's not in its infancy; it's a very straight-forward process.

Q Well, I don't know if we can compare straight-forward with whether it's in its infancy state or not. Would you say that we could classify it as at its elementary form as of now? You are conceivably, I assume, attempting to improve it, are you not, as time goes by?

A Certainly.

Q And you anticipate that there will be changes made?

A Yes, the principle way that you can improve a sectoral forecast is to deal with more sectors and to have better base line information.

Q And this, of course, is going to take time?

A It takes some time and some money to obtain basic information, that is correct.

Q Has any utility company in the Pacific Northwest adopted this approach?

A To my knowledge, no utility in the northwest has ever disclosed its complete method of forecasting. Now there is a possible exception here in that the Bonneville Power Administration which prepares forecasts, or aids in the preparation of forecasts for small public utilities in the northwest, does publish a load forecasting manual which I have and have read; and they also do respond to direct technical questions. I must say that I've always had excellent cooperation from Bonneville as well as from other utilities in asking a specific question; but going back to the issue here, no, I am not aware that any utility now does this, or has, in fact, published its total forecasting method. What we see are the totals, and those show up each year in the PNUCC forecast.

Q Well, it isn't a hard problem to find out how utilities, each individual utility company, approaches the problem of forecasting, is it? It's not a secret of each individual company, is it?

A It's only a secret if they consider it a secret.

Q Well, you heard Dr. Shaw's testimony yesterday?

A Yes, sir.

Q Where he went around to the five applicants and received information?

A Apparently some of the information he received was not the information that he needed since, on several occasions, you corrected that information for him.

Q Well, that may have been true as far as minor figures are concerned, but didn't he testify that he found them completely cooperative and that he obtained the information that he needed from them?

A I will stipulate for the record that I've had excellent relations and cooperation from all the utilities in the northwest and Bonneville Power Administration whenever I could frame a question and find the individual with the answer. I have never been denied information on an aspect of their operations, except for future planning and the policy of load growth. I have never gotten an answer on that from any utility, and I have been less than satisfied with the answers I've gotten from Bonneville Power Administration.

Q Have you pursued that line of endeavor?

A I respect the privilege of a private corporation, which is in business to make money, to keep its future marketing plans as closely held information. No, I have not pursued this.

Q All right. Now to get back to my question. You heard Dr. Shaw testify, did you not, that he received complete cooperation and, in fact, in his prepared testimony he goes into detail into the method of forecasting used by each of the five applicants, doesn't he?

A Yes, sir. I would be surprised if he got anything less than good cooperation.

MR. BELLINGHAM: Fine. This might be a logical time to recess.

HEARINGS EXAMINER: All right; we'll take a recess.

(RECESS AT 10:45 A.M.)

Following a brief recess, the hearing reconvened at 11:10 A.M. on February 18, 1976.

HEARINGS EXAMINER: Are you ready, Mr. Bellingham?

MR. BELLINGHAM: Yes, sir.

HEARINGS EXAMINER: Okay, sir, if you will resume your seat, we will proceed.

CONTINUATION OF EXAMINATION OF WILLIAM A. BREWER

Cross, by Applicants

By Mr. Bellingham (continuing):

Q Back on your testimony again, Dr. Brewer, at line 22 --

A On page 5?

Q Yes, sir. You indicate there that utility forecasts tend to be on the high side?

A Yes, sir.

Q Yes, and that's based on your observations of utility forecasts over a period of time?

A It's based on the observation of the forecast as compared to the actual consumption, so I think it's not open to question.

Q Well, we have had testimony in this case regarding what will happen if utilities forecasts are on the high side as compared to the low side; we've also had the problem of whether it's better to underforecast or overforecast, and I am wondering if you are familiar with the testimony of Mr. Goldhammer and Kent Anderson relative to this?

A I'm not familiar with their testimony in this procedure.

Q Well, do you feel that it's better to forecast on the high side or on the low side, or do you have an opinion on that?

A I think it's best to forecast as close to the mark as you possibly can.

Q And I think you will agree, won't you, that all utilities are attempting to do that honestly?

A No, I would not subscribe to a statement that all utilities are attempting to do that?

Q All right; let's confine it then. Now what about the five utilities in this case; do you think that some of their forecasts are dishonest ones?

A The honesty of a forecast I cannot comment on; the accuracy of a forecast I can comment on.

Q All right, well, don't you think, and let's go back to the original question, that they are attempting to forecast based upon the facilities that they have at hand in as efficient a manner as they can?

A Efficiency in a corportation, the five corporations that we are talking about here, I interpret as being efficiency in any corporation; you do the best you can for your company.

Q Fine.

A And I would say that a good forecast is the one that does the best for the company.

Q And it's up to the company, isn't it, it's to their advantage and to their benefit that they forecast correctly?

A Under the rate of return system for private utilities, it's to the advantage of the company to sell as much electrical power and to have as large a rate base as it can. It is not to their advantage to have unsold capacity, and this is increasingly true; that's a disaster.

Q Well, that brings us back to the subject of what we talked about a few seconds ago, and that is whether you underforecast or overforecast and certainly, as you indicate, it is not to the utilities benefit to put on line generating units that they can't utilize, is it?

A It certainly is not; somebody has to pay for it.

Q That's right; it's wasted power if they can't use it?

A It's wasted money.

Q Yes, and so as a practical matter, they build these generating units based upon their forecasts, basically, don't they?

A Well, as a general statement, any utility is going to add resources based on its forecasted demand.

Q Right, and so it's to their benefit, is it not, that they forecast as accurately as they can?

A Are you talking in general on utilities, or are you talking about the five applicant companies?

Q No, I'm talking in general on utilities.

A In general, for all utilities a good forecast, an accurate forecast, is advantageous.

Q And that holds true as far as the five applicants in this case is concerned; are you willing to concede that?

A The five applicants in this case operate as private corporations. It is to their advantage to maximize the economic return to the owners of the company; that is the primary advantage. Now I am aware that all five utilities, in fact all utilities, public or private, also have obligations in the area of public service, and I think that the five applicant companies here are good utilities and they do recognize public service. The fact is it's the bottom line where you make it or break it in the utility business, just like any other business.

Q Well, it's certainly not to the benefit of these five companies to have facilities on line that they cannot use; is it?

A Sir, I think it is to the benefit of these companies, or any similar private utility, to build as much capacity and sell it as they possibly can.

Q Fine, but to get back to my question; it certainly is not to there benefit to have facilities on hand that they cannot utilize?

A Unless there is a compensating mechanism in the rate of return business. If the rate of return pays off the investment, then it's a matter of economic indifference to the company whether or not the capacity is sold.

Q Well, you're not saying that these companies would put a unit, or units like 3 and 4, on line expecting that they will not utilize it?

A That's an area of conjecture that I just am not prepared to deal with; I don't know what the guiding policy is in this case.

Q Well, do you know what the obligation is of most private utility companies to their customers?

A To their customers?

Q Yes.

A Yes, it's generally spelled out in law.

Q Right.

A Or sometimes in regulation, it's to provide service.

Q Right, to provide service at the lowest possible cost, isn't that right?

A To provide service of a high reliability at the lowest possible cost.

Q Right.

A That's why we have public service commissions.

Q So we agree upon their obligation, don't we?

A The obligation to ensure the lowest possible cost is one which is generally assumed by government, not by the utility.

Q But I am talking about the obligation placed upon them, through law or otherwise, as just what we talked about?

A That's the way that I read the law.

Q And if they don't provide these services for their customers, they are in trouble, aren't they?

A It's the reliability clause, yes.

Q There's no question; they are in trouble if they can't provide the needed services?

A That's why governments grant monopolies to utilities.

Q Right, but to get back to my question; if they can't provide the service to their customers, they're in trouble, aren't they?

A Utilities that have been unable to provide service to their customers are often in trouble in the business sense.

Q Yes, they certainly are, aren't they?

A Yes.

Q And this could lead to a slowdown as far as industry is concerned, it could lead to unemployment; there are any number of factors it could lead to, the results, aren't there?

A Well, it could lead to, in an extreme case, it could lead to the failure of a utility which is engaged in public service, and that's to nobody's interest. We don't want to see any private utility go under.

Q Right, but it could lead, also, to interrupted services, lack of services, unemployment, and so forth?

A It could lead to a number of consequences in any given situation.

Q Yes, right, but the ones that I particularized to it could lead to, could it not?

A It could in a given situation.

Q Yes. You talk about the West Group Forecast in your statement, and on page 8 I notice you indicate that included in the West Group Forecast are loads and resources of the significant private, public and federal utility systems, except the Idaho Power Company. Do you know whether Montana Power Company is included in the West Group Forecast?

A It's my understanding that the relationship of Montana Power Company to the West Group Forecast is peripheral. Now included in the state of Montana, of course, are the Bonneville loads in western Montana, west of the divide. Through exchanges or contractual agreements I'm sure that the loads and resources of Montana Power Company could enter into it, but it's not the West Group Forecast, it's not the west group of the northwest power pool.

Q Well, actually at present Montana Power statistics are not included in the forecast.

A That's my understanding.

Q Yes. Now let's take a quick look at Exhibits 110 and 111, if we might. Let me ask you, to begin with here, whether or not these two exhibits are based upon the same data?

A Yes, sir; all data from BPA and PNUCC. I've used no other data sources in here.

Q All right, do you have Exhibit 110 before you?

A It's in front of me.

Q When does the actual load, and the actual load in that particular exhibit is indicated by a dotted line; isn't that right?

A That is correct.

Q And when does that load begin to flatten out?

A It begins to flatten in the mathematical sense, if you view this as a curve, where the derivative goes to zero. Now what that means in ordinary terms is that as soon as it starts to bend over to the right, it's beginning to flatten. As a practical matter, I would say that the flattening becomes significant in 1969, the year 1969.

Q Fine, and at that point, how many megawatts are involved?

A You mean the total load, the system load?

Q On the lefthand side, yes.

A Slightly below 11,000 megawatts.

Q Now turn, if you will, to Exhibit 111, and here again actual load is indicated by a dotted line; is it not?

A Yes, sir.

Q And where would you -- when would you say the actual load commences there, the flattening out?

A The first flattening, of course, is the same one and the same numbers done in the '69-'70 period, but the more marked flattening, and the point that I've tried to bring out in my testimony, is since about 1973, '72-'73.

Q '72-'73. And what is the megawatt load at that time?

A Perhaps 12,500.

Q Now then calling your attention back to Exhibit 110 again, what is the load level in 1970?

A About 11,000.

Q And calling your attention to Exhibit 111, what is the load level in 1970?

A About 11,000.

Q Pardon me?

A About 11,000.

Q In 1970?

A '70.

Q I'm calling your attention to Exhibit 111?

A No, sir; it's about 10,000.

Q Well, actually it's a little below 10,000; isn't it?

A Yes, sir.

Q Pardon me?

A Yes, sir, it is. It's quite possible that there is a drafting error on this.

Q Well, when you compare Exhibit 110 to 111, I notice several errors in there, and this is the ones that we've gone over; there may be others, I don't know. You say it's a drafting error; I assume that you did not do the actual drafting here yourself?

A Yes, sir; I did the actual drafting.

Q Did you?

A Yes.

Q And apparently a mistake was made in the actual load curves between the two exhibits; is that right?

A Yes, sir; I appreciate your calling my attention to that. I will have to review this; it's possible that I've displaced the numbers on the vertical scale on the left.

Q Well, there seems to be errors not only in the figures that you have brought out as far as the year 1970 itself is concerned, but there also appears to be errors as far as the flattening out of the curve that we've previously discussed, doesn't there, as far as these dates are concerned?

A I have to go back to my original drawings; these are drawings copied from something that was done on graph paper, and I do not have the scale here; so I would ask your indulgence to check that with my originals and cross check it and make any corrections that are necessary.

Q Well, it does appear that a correction is necessary as you look at it now; isn't that right?

A It appears at this time that I believe I may have displaced the vertical scale here.

Q Now then calling your attention to page 10 of your testimony, line 2, you indicate that at the present time, at the end of January of '76, the West Group area is about 2,000 megawatts below the latest forecast in average energy?

A Yes, sir, that is correct.

Q Now you're not talking about a comparison between the January figures with the December figures, or the Janaury figures of

'76 with the previous January figures, that would be 1975; but you're talking about the figures compared to the latest forecast?

A Let me tell you exactly where that figure came from, sir. In preparation for this case I called the Seattle office of Bonneville Power Administration, Mr. George Tupper, the manager, and I asked him for a figure for the 1974-'75 power year, the year ending with the fiscal year of Bonneville, for firm energy loads for the coordinated system. He gave me the figure of 11,822 megawatts; this was done over the telephone. Actually, I talked to Mr. Tupper and one of his engineers called me back the next day. I compared that with the current West Group Forecast which was about 14,000 megawatts at that period, and that's where I came up with the figure of about 2,000 megawatts below the latest forecast in average firm demand.

Q Do you know whether those figures were temperature?

A Corrected for temperature?

Q Yes.

A No, sir, I would assume that they were not since they were rather preliminary figures, and it took some investigation to get them. Also, the figure of 11,822 was given to me with the idea that it is possible that it included some minor interruptable loads of Bonneville itself. So it was a preliminary figure.

Q Yes, and that would be subject to change?

A It would be subject to change during the accounting period, obviously. I did notice that the Bonneville regional advisory council meeting in Seattle a few weeks later, where I spoke to Mr. Hoedell about this. He was using a graphic, not a precise one, but similar to mine, which showed a figure of above 12,000, slightly above 12,000 as I interpreted it from the graphic. So, obviously, there is some accounting that has to be done to get the final figure.

Q Right, and his figure of 1,200 you say?

A Twelve thousand megawatts.

Q Would be different than yours as far as --

A It would be different from an 11,822, yes.

Q Yes, right. All right, now then as far as the forecast itself is concerned, that is temperature corrected; isn't it?

A The West Group Forecast has to assume a standard condition, obviously.

Q Right, so we can then say that it's based on normal temperatures, isn't that right?

A Yes, sir.

Q Well, now this particular figure of 2,000 was obtained at the end of January of '76, and that figure applied over how long a period of time? Is that the January figures or is it a yearly figure?

A Bonneville Power Administration publishes a monthly power situation summary, which I requested and receive, which, among other things, tells you, I believe the title of it is Coordinated System, and it tells you month by month what consumption has been and how it compares to consumption for the previous year. This has actually been coming out for a couple of years now, and it's shown as a percentage of last year. In other words, if you're below last years consumption, it shows as 99 percent or 85 percent; if you're above last year, it's 101 or 103.

Q Now on page 11, line 13, you indicate that the current 2,000 megawatt decline from projected consumption is a discrepancy of over 14 percent. Now what figures did you use for that; do you have them with you?

A No, sir, I do not.

Q When you talk about decline --

A I'm talking about actual versus forecast.

Q Right. Forecast by whom?

A West Group Forecast.

Q You're talking about the West Group Forecast. You state here very boldly a discrepancy of over 14 percent, but you don't have the figures with you; is that right?

A I do not have the notes for this preparation with me.

Q All right. I think on page 12 you indicate a reason for drop, apparently, near the top, is demand elasticity, and you also mention conservation. Now I think we've pretty well established also that the recession that is presently occurring has a tendency in this regard also, isn't that right, along with the others?

A A downturn in overall economic activity certainly can be interpreted as a cause of decline in electrical consumption. There is no arguement over that?

Q I note there at line 7 on that same page you indicate that recovery from the economic downturn/recession undoubtedly will increase electrical demand, and this is consistent with what you have previously indicated on the stand?

A Yes, sir, no argument.

Q Pardon?

A No argument.

Q At the bottom of page 12, you talk about an illustration there if residential electrical rates rise to an average three cents per kilowatt hour. Now that's based upon a supposition, is it not, the illustration?

A You mean the figure of three cents per kilowatt hour?

Q Yes.

A Yes, that's for illustrative purposes.

Q Fine, because you use the words if residential electrical rates rise so --

A Yes, sir.

Q You're assuming here that right now residential rates are not up to three cents per kilowatt hour?

A In the Pacific Northwest they are not; in many areas of the country they are well above that.

Q I see, fine. Do you know what the average may be as far as the five applicant companies are concerned?

A I would guess that it's in the range of 15 or 16 mills as an average.

Q Well, would you put that in cents, if you will?

A In a sense?

Q Yes, a common denominator; you talk about cents, c-e-n-t-s, not s-e-n-s-e.

A Oh, 1.5 or 1.6 cents. I'm aware, for example, that Washington Water Power has residential rates lower than that; I believe that Portland may have some higher, and also there are differences in the schedules to an individual residential consumer. It depends on the utility's rate schedule and his contract with the utility.

Q Now in this computation, did you take into consideration any electric heat conversion?

A Yes, sir. I start with the conversion of electricity and BTU's at the rate of 3,413 BTU's per kilowatt hour; that's the perfect or the ideal conversion.

Q And when we talk about conversion efficiency as applied to electric heat, what are we talking about?

A It depends on where you start counting line losses. If you start out at the box on the street there, they're rather small. Certainly your efficiency is going to be on the order of 95 percent.

Q Pretty close to 100 percent as far as electric heat is concerned?

A Ninety-five percent is close to 100 percent, yes, sir.

Q In other words, the loss is very minor in the home?

A Compared to the loss in generation, for example.

Q Right. Well, what about the heating of a house, for example, as you have done in your hypothetical example here of heating oil. What is the conversion efficiency there; do you know?

A I have an oil furnace in my house which I installed last year which is producting heat into a heat exchanger, it's an efficient set-up, at 85 percent. Now that's well above the average.

Q Wouldn't you say that the conversion efficiency applied to oil generally in the house is around 65 percent, somewhere in that neighborhood?

A It depends on the house and it also depends, in large measure, when you make a comparison of this type, as to whether the house was designed for electric heat or oil heat or gas heat. If you set up for electrical resistance heating today, or if you put in such an installation in the last 10 or 15 years, if your builder was any good at all, he gave you a well insulated house, and several thermostatic controls through the house so that typically, in good practice, you find a much more efficient house, energy efficient house, associated with electric heating; otherwise you would have an astronomical heating bill.

Q Well, you indicated that your figure was too high; you said 85 percent, did you not, or 80 percent, whatever it was?

A It's high, yes.

Q Yes. What would you say the average might be?

A A well maintained oil furnace with well designed flue and a cold air intake, in my estimation, could operate at a system efficiency on the order of 70 percent, 72, 74.

Q Well, it could, but what about the average do you suppose, 65 percent?

A Sir, I identify this as something that we simply do not know; it's a figure that many of us in the energy business would like to know. We'd like to go out and measure average efficiencies. You can speculate that many installations are operating very inefficiently, or maybe the people are changing the filters. I simply do not know what average practice is in the northwest.

Q Are you aware of the fact that figures have been established insofar as the Montana Power territory is concerned that it is presently cheaper to heat with electricity rather than oil?

A I'm not aware of the study.

Q Would you be surprised?

A I would not be surprised if a study had been made; and I would assume that they were made on identical houses, identical in every sense, that is not allowing for better insulation in the electrically heated house.

Q You're not aware of any such study?

A But I'm not aware of the study, as I said.

Q All right now on page 13, line 14, you talk about northwest light metals industry and so forth, and you go on to expand this. Yet, as a practical matter, you are aware as far as aluminum figures are concerned the applicants in this proceeding do not serve any of the aluminum loads?

A I am aware that at least one of the applicants in this proceeding does serve small loads to the light metals industry.

Q All right, are you including aluminum in that?

A Alcoa. I believe Alcoa gets some power from the Washington Water Power Company; I'm quite certain of that.

Q Do you know what amounts?

A It's relatively small; it's not hundreds of megawatts.

Q It's what?

A It is not hundreds of megawatts.

Q It would be below a hundred megawatts?

A Yes, certainly.

Q Now let's turn to page 16, and at line 9, you come up with the conclusion that Colstrip 3 and 4 are not essential to serving overall Pacific Northwest loads in the time frame for which they are being proposed. Now have you studied the exhibits of the applicants in this case as far as their load forecasts are concerned, and the projected deficiencies in the future?

A No, sir, I have not studied the forecasts of the applicants in this case. My comment here, and I used underlining, is overall Pacific Northwest loads. I am not here to say that I know what the situation is with these applicants or Montana Power Company.

Q All right, now as a practical matter, your entire testimony here is directed toward the Pacific Northwest, isn't it?

A Yes, sir, as if it were operating as a single system; this was my instruction from counsel.

Q Fine, we understand that; and insofar as the application is concerned to particular companies in this case, the applicant companies, it may or may not have an application to them individually?

A That's the subject of other testimony; it's not my part of the case.

Q And you have not gotten involved in this?

A No, sir.

Q Right. And the fact that you have not studied the particular forecasts' resources of the loads and resources of the applicant companies in this case results in the fact that you cannot tell us today whether or not Colstrip 3 and 4 are or are not essential to serve their needs in the future?

A Their needs as distinct from overall Pacific Northwest needs?

Q Right, and I'm talking about their, I'm talking about the applicants' needs?

A That's outside the scope of my assignment.

Q Fine, and I assume because you have not studied the individual applicant companies in this case that you are not in a position, as you indicated, to give us your opinion relative to the construction of 3 and 4 as being essential to them?

A No, sir, I believe that was covered in Dr. Shaw's assignment and testimony of the other day.

Q Right. At page 16, line 24, you talk about WPPSS number 5 relatively uncommitted at the time of startup. Do you know when that is scheduled to come on line?

A The schedule keeps changing, as it does with all nuclear power plants today; it's a mid '80's development.

Q Right, and if I told you it's scheduled, as of now, to come on in March of '85, I assume you would have no dispute with that time schedule at this time?

A Well, that sounds reasonable.

Q I think that's in one of the exhibits at this time. Well, as a practical matter, if a utility is facing a shortage in '79 or '80 or '81 or '82 or '83, this particular unit that you refer to in your testimony is not going to be of any assistance to them, is it, in meeting that shortage?

A Are we talking about only projected shortages for periods before 1985?

Q Yes.

A Okay, the testimony in relation to the second unit at Satsap, Washington was that it would be uncommitted at that time. Now that assessment, which was made by the applicants in the case, logically would mean that there was -- that all loads were being served on March 1, 1985, or whatever the date is; that's what uncommitted means to me.

Q Yes, fine, but this particular unit that you refer to is not going to help any utility prior to the time it comes on line to meet their shortages, is it?

A If they have a shortage.

Q Right.

A Obviously, a 1985 plant can't help a 1980 shortage.

Q So for the purposes of forecasting as far as these particular utilities are concerned for the period prior to that time, this particular unit does not come into play; isn't that right? There's no problem there; we agree on that, I'm sure, don't we?

A I think we've covered that.

Q And the answer is that it doesn't help, isn't that right?

A A 1985 plant cannot help a company in 1980.

Q Turning over to page 18, you forecast that beginning in the '80's, growth rates between 2 and 3 percent annually are going to be the norm?

A That is my opinion.

Q Right, and that opinion of yours is directed to the Pacific Northwest?

A Yes, sir.

Q And what about the country as a whole?

A In my opinion, the country as a whole will show certainly lower growth rates than in the past. Now whether 2 percent or 3 percent or even greater than 3 percent is going to be the norm, I have not attempted to evaluate. In my study of the northwest, I have used, for example, the same census population forecasts, supplemented by state forecasts, that the utilities do, in most cases now the census series E; it's business and economic forecasts mostly built up from state data. So while I'm reasonably confident in what I say about the Pacific Northwest, I would have much less confidence in extrapolating this to the country as a whole.

Q Well, in the past the Pacific Northwest growth rate has been greater than the country as a whole?

A The Pacific Northwest was a latecomer, no question.

Q So it has been greater, hasn't it?

A Yes, overall physical and economic development in the Pacific Northwest came later than it did in other parts of the country.

Q Now this forecast of yours, between 2 and 3 percent, that is your own individual forecast?

A I first estimated in a much cruder way a growth rate of about 3 percent in a paper that I delivered, an invited paper, to the American Society of Civil Engineers on May 3, 1974, which was prepared in January or February of 1974. The paper was entitled Energy Growth Rates and Policy Development, and at the original deposition I understand that the applicants have this. That was my own sole estimate, and I certainly would not dignify it by calling it a formal forecast. Since that time, Exhibit 115 in this case is what I would call more comprehensive and sophisticated analysis: and that is where I come up with the 2 or 3 percent figures here.

Q And I'm sure that we can agree on this that there is reasonable room for disagreement among well-intentioned people insofar as this forecast of yours is concerned, isn't there?

A There is room for disagreement for any reason; there obviously is disagreement.

Q And in any forecast there is room for disagreement, isn't there?

A Yes, I consider that a healthy sign.

Q And you, of course, are aware of the fact that other people have forecast differently as far as the Pacific Northwest is concerned over this period of time?

A I have the forecasts, yes, sir.

Q Pardon me?

A I have the forecasts which differ from Exhibit 115.

Q Right. What forecasts do you have that differ?

A The West Group Forecast.

Q Right. Any others?

A I have only the figures presented by Dr. Anderson who, apparently, indicated to the Washington state agency that I sited, the Thermal Power Plant Site Evaluation Council, that he had done another analysis, and he comes up with figures between 3 and 6 percent annual growth which would be different both from Exhibit 115 in this case and from the West Group Forecast.

Q Now you were here during Dr. Shaw's testimony, weren't you, the last couple of days, as I recall, and you remember his forecasting as far as the individual companies are concerned in this case?

A I was not paying strict attention to the exchange here in the last couple of days. I haven't read Dr. Shaw's statement.

Q Well, when you say the 2 and 3 percent annually are going to be in the norm, you're applying that to the entire Pacific Northwest and not to these individual companies, aren't you?

A As I stated before, my assignment in this case was to deal with the Pacific Northwest, not with the applicant companies and certainly not with Montana Power Company; it's another situation.

Q And did you hear Dr. Shaw testify yesterday that insofar as his forecasts are concerned, and the forecast of his company, Commonwell, that the total composite forecast of average energy for the five companies that are applicants in this case over the next ten years is an average 5.96 percent?

A I do not recall hearing that figure; I do recall hearing a number of figures for the individual companies, but, as you will recall, the testimony and the examination of testimony was quite lengthy.

Q Well, do you recall his forecast as far as peak is concerned for the five applicant companies over the next ten year period annually would increase 5.90 percent?

A I do not recall that specifically; I'd have to consult the record.

Q You don't disagree with those figures that I've given you, do you?

A I cannot agree or disagree with Dr. Shaw's testimony since we were working on different assignments, and I had no review or involvement in his preparation.

Q Now are you aware of the fact that the United States Bureau of Mines national energy load growth prediction for the period from 1974 through 2000, in the electrical section, upon a national basis is 6 percent?

A I'm not aware of that; I have seen publications of the Bureau of Mines with which I am somewhat familiar as an agency, and it's my understanding that they do not perform forecasts, but that they utilize data from other sources, primarily industry sources. I have seen figures sited by various federal agencies and non-federal agencies working on federal contract which differ markedly from 6 percent.

Q Are you aware of Edison Electric Institute's forecast for the period of time that we are talking about, for the next 15 to 25 years, indicates that electric energy consumption would increase at an average rate of 5.3 percent to 5.8 percent under a moderate growth scenario?

A I'm certainly aware of the EEI forecasts in statements over a period of time. I do not recall that exact figure.

Q Now I think you indicate here on page 18 that by the beginning of 1980 the growth rates of between 2 and 3 percent annually are going to be in the norm. What about the figure between now and the 1980's?

A Between now and the 1980's, as I noted here on page 18, certainly there is going to be a higher, in my opinion, there is going to be a higher year by year growth rate than 2 percent, say. You can't get from either the forecast 4.7 or 4.9 percent, which is now in the West Group Forecasts, to a lower figure without going through a period of transition.

Q Let's put a time frame upon this, if we can. Your 2 and 3 percent annual figure in your testimony, you say in the beginning of the 1980's; what year specifically are you talking about?

A The beginning of the 1980's would be after the year 1980.

Q After the year 1980; commencing with the year 1981?

A Yes, sir.

Q All right. Now then up to the year of 1981 you say the growth rates are going to be more than 2 and 3 percent. Do you have any idea as to what it might average annually?

A No, sir, I don't. At the present time, on a month by month basis, load growth, as a matter of fact, is like 2 percent; but I expect that to go up sometime between now and the beginning of the year 1981, and then to level off again. That is my opinion.

Q When you say go up, what figure do you have in mind?

A You're talking about an incremental growth rate; in other words, you can extrapolate from one month to the next the load growth in that month and make that an annual percentage growth rate. This is very common practice. So over a period of say six months, we might be growing in electrical load at an annual rate of 5 percent; and then in the next six months we might be growing at an annual rate of 4 percent. It is, in my opinion, an imponderable if you start breaking it down into monthly and semesteral periods.

Q Well, what about a yearly basis, though? Do you have any figures?

A No, sir, I do not have any figures, calculated figures on a yearly basis.

Q But it is going to be more than 2 and 3 percent? Would you give us a range perhaps during this period of time up until 1981?

A I would make an estimate, which is solely an estimate, that we will not exceed the 5 percent figure during that period.

Q But the growth rate could be up to 5 percent during this period of time?

A As a guess on my part, up to.

Q And the 2 to 3 percent figure annually after 1981 is a speculation on your part, also, as to what will happen?

A The 2 to 3 percent figures come out of Exhibit 115 which is a sectoral forecast. Now if the values for the variables used in that forecast are even close to the figures that we have used here in 1976, then the load growth rate will be between 2 and 3 percent, depending on the scenario and the price of alternative fuels and all the other situations which we have allowed for in Exhibit 115. So it is not speculative, it's mathematical if the sectors perform as we have guessed that they would perform; in other words, population growth follows the census E curve, etc., etc.

Q When you use the word guess, when you talk about the load growth on the various sectors that you talk about, you do not know, of course, what those are going to be; so what you do is attempt to analyze it and guess as to what it will be during that period of time; isn't that right?

A That is correct. The way we approach it is to look at the underlying causes, fit those into a system equation, attempt to use reasonable values, or ranges of values for the variables, again in the mathematical sense, and the figure then is determined, you might say, automatically by summing the valuables and crunching them through the equation.

Q Now the final hypothesis, or conclusion I guess I should say, in your summary is that some load growth will prevail; it is likely to be at half the previous annual rates. What previous annual rates are you talking about?

A I'm talking about 6 percent annual rates which we have experienced in the Pacific Northwest for periods more than a year, some cases five or more years, the so-called historic rates of growth.

Q And then if you cut that in half, you come up with a 3 percent growth; isn't that right?

A Yes, sir; as I indicated in another part of my testimony, for numbers like this you can also relate these to the doubling times. In other words, using the little nemonic early in my testimony that if you take the annual percentage growth rate, or growth rates between about 1 and about 12 percent, divide that into the number 72, and you come out with about the number of years in a doubling time; and I think that's an important consideration. If you cut the growth rate in half, you have approximately twice the number of years to double your system.

HEARINGS EXAMINER: Do you want to recess for lunch, or do you have some more?

MR. BELLINGHAM: I have more, but very little, so that will be fine.

MR. SHERIDAN: Why don't we then before we take off, put the next public witness on the stand and let him go?

HEARINGS EXAMINER: All right, sir. I'm sure that will be agreeable with you, won't it, Mr. Pike? Do you want to come on up and we'll swear you?

(Mr. Brewer steps down from witness chair temporarily.)

EUGENE PIKE, appearing as a public witness, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

HEARINGS EXAMINER: Now, Mr. Pike, in this proceeding, I don't know whether I explained this to you back there, if you have a written statement, we simply file that and present it to the board rather than have you read it, and then we transcribe it and rewrite it, and give it to the board anyway. So it saves us a lot of time. Your written statement will be received in evidence in this proceeding, and if you will be seated, Mr. Sheridan can ask you some questions on your statement.

(THE WRITTEN DIRECT TESTIMONY OF MR. EUGENE PIKE WAS DIRECTED TO BE INSERTED AT THIS POINT.)

February 18, 1976

STATEMENT OF EUGENE PIKE BEFORE THE MONTANA BOARD OF NATURAL RESOURCES AND CONSERVATION RE: COLSTRIP #3 & #4

My name is Eugene Pike of Missoula, Montana. I am in my 30th year as the Manager of the Missoula Electric Cooperative. From a very small beginning in early 1938 the cooperative has grown to an electric system serving about 4,500 consumers over 1,175 miles of electric lines in six western Montana counties and in Idaho County, Idaho.

The cooperative has a utility plant investment exceeding $7 million at present and experiencing substantial growth in number of consumers, electric power requirements and plant facilities. Our plant investment increased by about $850,000 in 1975. In the last ten years we have extended service to about 2,200 additional consumers; our miles of line has increased by 350 miles and our utility plant investment has increased by about $4.2 million. We invested more money in plant in the last 10 years than in the previous 25 years.

During the same time our annual kilowatt hour requirements has risen from about 26 million in 1965 to 75 million in 1975. This is a compounded rate of about 11.3% per year. Our peak demand shows similar growth.

Long experience in this business causes me to believe this trend will continue. People will always want the services that electricity can bring to them. We are aware of the necessity to stretch our energy supplies and not waste them; but, this does not mean that people will voluntarily eliminate the useful use of energy if it is available at a price they can afford. They expect their utility to have it available in whatever quantities they wish to use, regardless of the need, or alleged need to restrict it's use to essential uses.

I believe we still will have growth comparable to the past -- unless the roof falls in, in our area. As far as adequate quantities of electric power are concerned, we may be approaching that point much more rapidly than people are willing to believe.

Our electric cooperative, along with the rest of them which are within the Columbia River drainage, purchases most of it's wholesale electric power and energy from the Bonneville Power Administration as a preference customer. We purchse some power from the Montana Power Company directly; but, all of the Bonneville power comes through the Montana Power lines to us through wheeling agreements between the Company and Bonneville. The cooperative has no generation of it's own. The actual source of the cooperative's power at any instant and location depends upon how the power pool is being operated. Part of our monthly bill goes to the Washington Public Power Supply System at Richland. We do not know if any of the actual power generated at the Hanford Plant, in which we are a participant, ever reaches our system; nevertheless we pay for it as if it did. The same thing holds true in Montana. The power we pay Bonneville for may be generated by Montana Power Company or some other utility. We do not try to identify the kilowatts and kilowatt hours - they are all the same color.

What I am saying is that any generating project in the Pacific Northwest or on the Montana Power Company's system is of direct concern to our cooperative. All of us are in this together. We are involved in the Pacific Northwest Hydro-Thermal power program - we are obliged to share the adequacies, deficits and risks involved in pursuing adequate supplies of electric energy - we are committed to the necessity of standing up for feasible generating projects over the entire area.

Despite all of the efforts of about 110 utilities and the Federal Government involved in the program we see ominous signs. We received a letter dated January 9, 1976 from the Bonneville Power Administration, predicting possible energy shortages of maybe 2 million average kilowatts in the 1978-1979 water year and presently undetermined shortages after that. This is due, primarily, to the various delays encountered in generating plant authorization and construction in the northwest; and the picture is not improving. This letter tells us that our cooperative must share in any shortae and that we should get busy formulating plans for curtailing power deliveries when and if it becomes necessary over the region.

When this time comes, the cooperative's preference and priority for Bonneville power will not carry much, if any weight.

Included in the Pacific Northwest power supply program are Colstrip #3 and #4 projects. A major portion, reportedly about 70% of the power and energy from these plants is destined to go to the power pool which feeds our cooperative. It is just as much a part of our power supply as if we built our own generating plants in our own backyard; and, as are the generating plants in the state of Washington and Oregon. We have been participating in the nuclear plant at Hanford for many years and plan to participate in other nuclear plants in Washington.

The publication, Northwest Powerful Facts, Volume III, No. 1, lists the 20 regional power plants presently under construction or proposed and shows that most of them are behind schedule, up to as long as three years. It shows Colstrip 3 & 4 as being 28 months behing schedule. The total list shows 9 coal fired plants, 1 oil/gas turbine, and 10 nuclear plants. Totalling up the difference between original dates and presently estimated on line dates, this list shows a total delay of nearly 25 years. The naked truth of the matter is that the only plants shown to be on schedule are Colstrip #1 in 1975, Bridger #2 in 1975, Beaver Turbine in 1977 and Boardman in 1980.

The concensus of the northwest utility people and the Federal Government through the Bonneville Power Administration is that equivalent output of all of the plants listed will be necessary on the original schedule. Obviously, we are in trouble, unless some serious errors have been made in load forecasting on the liberal side, which I doubt has happened. In view of the problems with petroleum products, we can expect accelerated demands for electricity. I am sure this is already happening at our cooperative.

I started this discussion by showing our cooperativ's load growth and making the statement that it probably will continue at at least the same rate into the foreseeable future. It seems that whether or not our cooperative's load grows, we may be facing power curtailment within three years. We are supposedly protected by a requirements contract with Bonneville; but, it is reasonable to assume that we will have to share shortages with our neighbors throughout the region.

As the Manager of the Missoula Electric Cooperative I believe it is my responsibility to support the authorization and construction of electric generating plants that will be contributors, either directly or indirectly, to the power supply of the cooperative.

Further, in view of the serious delays in most of the projects in the northwest, it is advisable that we construct those plants which can be gotten into service in the quickest time. This means coal fired plants, assuming that large scale use of oil/gas turbines is not practical. Obviously, Colstrip #3 & #4 fit this description. I urge their authorization and construction as early as possible.

I can do no less.

With the permission of the Department, as a part of this statement, I would like to include a tabulation of the Missoula Electric Cooperative's energy purchases from 1960 through 1975 inclusive as Exhibit A; a one page issue of Northwest Powerful Facts, Volume III, No. 1, as Exhibit B; and a copy of a letter from Bonneville Power Administration, dated January 9, 1976, to Eugene Pike, Manager, Missoula Electric Cooperative, Inc. and signed by Deputy Administrator Ray Foleen; identified as Exhibit C.

Thank you.

EXHIBIT A

MISSOULA ELECTRIC COOPERATIVE, INC.

Wholesale Power Purchases - 1960 through 1975

Year	Total Kilowatt Hours	KWHS Increase Over Previous Year	% Increase
1960	15,807,640		
1961	17,751,235	1,943,595	12.3
1962	20,631,180	2,879,945	16.2
1963	21,951,480	1,320,300	6.4
1964	24,324,020	2,372,540	10.8
1965	25,888,078	1,564,058	6.4
1966	27,898,006	2,009,928	7.7
1967	29,092,270	1,194,264	4.3
1968	32,935,495	3,843,225	13.2
1969	37,486,160	4,550,665	13.8
1970	40,351,420	2,865,260	7.6
1971	46,449,459	6,098,039	15.1
1972	54,574,440	8,124,981	17.4
1973	63,738,340	9,163,900	16.8
1974	67,702,080	3,963,740	6.2
1975	74,973,220	7,271,140	10.7

Kilowatt hours purchased in 1975 were 4.73 times those purchased in 1960

This is a compounded kilowatt hour growth rate of 11.1% per year

In the same period, the peak demand increased from 4,000 kilowatts in 1960 to 17,000 kilowatts in 1975 at a compounded rate of about 11.3% per year.

United States Department of the Interior

BONNEVILLE POWER ADMINISTRATION
P.O. BOX 3621, PORTLAND, OREGON 97208

OFFICE OF
THE ADMINISTRATOR

In reply refer to: A

January 9, 1976

Mr. Eugene F. Pike
Manager
Missoula Electric Cooperative, Inc.
P.O. Box 1486
Missoula, Montana 59801

Dear Mr. Pike:

At our November Customer Meetings I discussed with you the load forecast and delays that have occurred in the construction of regional generating projects. These delays could result in energy shortages starting in the 1978-79 water-year of 2 million average kilowatts. Similar shortages could occur in subsequent years. Although the current water-year is very good, I believe it is highly important that each utility plan now to develop a mandatory curtailment plan. Even a very successful voluntary conservation program, although necessary, will probably not be adequate to manage the forecasted electric energy shortages.

Every utility served by the Bonneville Power Administration will be affected by the shortages because our power system is interconnected and operates as an integrated system. A shortage of power in one part of the region will affect the entire system, and curtailment must be done on a systemwide basis.

I have requested our Area and District Managers to meet with you to discuss the load-resource picture in detail and discuss with you the need for development of a curtailment plan.

We hope, of course, that a combination of favorable events takes place and that it will not be necessary to place curtailment plans in effect. We must, however, plan a curtailment program in view of the forecasted deficits. To do otherwise would certainly not be in the best interest of power users in the region.

Perhaps your utility has already adopted a curtailment program. If so, we would appreciate knowing what steps you would plan to initiate.

Sincerely yours,

Ray Foleen

Ray Foleen
Deputy Administrator

cc: Mr. Joe N. Boyer

EXAMINATION OF EUGENE PIKE

MR. SHERIDAN: Prior to commencing cross-examination, I'd like to voir dire on Exhibit B to Mr. Pike's statement.

HEARINGS EXAMINER: Very well.

Voir Dire by Department of Natural Resources and Conservation
By Mr. Sheridan:

Q Mr. Pike, you have Exhibit B there which is entitled, Northwest Powerful Facts, published by the Public Power Council in Vancouver, Washington. Did you prepare that?

A No, sir, no.

Q Did you have anything to do with the preparation of that?

A In one way, but not directly. We're a member of the council.

Q Other than being a member of the council, you had no substantive input in the preparation of that exhibit; did you, none of the facts?

A No, sir.

Q And you aren't familiar with any of those facts that were used that are stated in that exhibit, are you?

A No, I'm taking their word for it.

MR. SHERIDAN: We'll object to the admission of Exhibit B on the basis it's heresay, self-serving, and not the product of this particular witness. It's an advertisement.

HEARINGS EXAMINER: That's just Exhibit B?

MR. SHERIDAN: Yes.

HEARINGS EXAMINER: Very well, I'll sustain the objection to Exhibit B, and I'll remove it from the statement that we are going to file. Do you have any further comments on the other exhibits?

MR. SHERIDAN: No further voir dire, thank you.

HEARINGS EXAMINER: Okay, you may cross-examine.

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Mr. Pike, your job is to provide power to your customers, isn't it?

A Yes, sir.

Q And your concern is to obtain all the power you can from any source whatsoever within your region to supply that power, isn't it?

A Yes, sir.

Q And you don't care whether it comes from a nuclear plant, a solar plant, a coal-fired plant, or a dam, do you?

A Not directly, no, I don't, sir. We are required to purchase our power from Bonneville Power Administration or Montana Power.

Q Why is that?

A Because of contracts we have with them; we are a preference customer under the federal law.

Q In fact, it's a condition of the charter of Bonneville Power that they provide you preferential treatment; isn't it?

A It's availability power only.

Q Right.

A And not for rate wise.

Q That's true, but you have first preference; don't you?

A Over non-public agencies, yes, sir.

Q That's right. And so the policies that BPA follows in making power available to you rather than say the state of California, would affect your ability to supply power to your customers?

A I don't quite follow you, sir.

Q Well, if BPA decides they're going to sell their power to somebody in the L.A. region rather than you, that affects you; doesn't it?

A They don't do that, sir.

Q Oh, don't they sell power in California now?

A With my agreement they do.

Q By agreement, but they can make those agreements, can't they?

A No, with my permission they do.

Q Assuming you have enough power, right?

A Assuming I have enough power; the federal law prevents Bonneville from selling that power to California if there is a need for it in the northwest.

Q And you're not going to give your consent to their sale of power to the southern portions of the United States like California if you don't have enough power here, are you?

A No, in fact, we've called some back from there.

MR. SHERIDAN: I have nothing further

HEARINGS EXAMINER: Very well, your testimony will go to the board as it is written, and thank you very much for your attendance. You are excused.

(WITNESS EXCUSED)

HEARINGS EXAMINER: What time do you want to recess to now? Is 1:15 all right? We will recess to 1:30.

(RECESS AT 12:05 P.M.)

Following the luncheon recess, the hearing reconvened at 1:30 P.M. on February 18, 1976.

VINCENT M. CAPP, appearing as a public witness, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

HEARINGS EXAMINER: Please be seated. Mr. Sheridan will ask you a few questions; please speak into the microphone to answer.

(THE WRITTEN DIRECT TESTIMONY OF MR. VINCENT M. CAPP WAS DIRECTED TO BE INSERTED AT THIS POINT.)

COMMISSIONERS:

Vincent M. Capp, Chr., Whitehall
Joseph Sologub, Elk Park
James Sanddal, Boulder

JEFFERSON COUNTY
CLERK and RECORDER
Boulder, Montana 59632

JOANNE P. McFARLANE,
County Clerk and Recorder

CARLA MATLACK,
Deputy

February 3, 1976

Board of Natural Resources
Joseph Sabol, Chairman
Helena, Montana 59601

Gentlemen:

The Jefferson County Commissioners at their regular meeting February 3, 1976, again considered the proposed construction of the two electric generating plants known as Colstrip 3 and 4 and their related transmission lines, and unanimously voted to ask to be placed on record as favoring the construction of this project and urge your approval of same.

After careful examination of the economic impact to State, local and more specifically our county government, it is our belief that the economic benefits outweigh the environmental considerations.

At a time when social services, health and welfare, and general needs of the people are creating heavier and heavier demands on county government, the resulting expanded tax base brought about by these plants and transmission lines will contribute greatly to relief of the never ending budget squeeze on the county and its taxpayers. Jefferson County would stand to gain approximately 223,442 dollars in taxable terminal equipment and transmission lines.

Further, Jefferson County depends heavily upon the agricultural industry and mining for employment and it is our wish that the construction of these plants be completed to provide an adequate supply of energy to insure the expansion of these industries.

In conclusion, it is our belief that the State of Montana has the laws, and methods of enforcement of these laws, to allow construction of these facilities and maintain an environment suitable to all concerned.

Yours truly,
Joseph P. Sologub
Board of County Commissioners
Jefferson County, Montana

Vincent M Capp

EXAMINATION OF VINCENT M. CAPP

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Mr. Capp, looking at your statement you make the comment that because Jefferson County would stand to gain approximately $223,442 in taxable terminal equipment and transmission lines, you believe that would be a benefit to the county; is that right?

A I do, yes.

Q Did you make any analysis to determine the effect of the construction of transmission lines through Jefferson County as opposed to the effect of hauling coal by rail through the state of Montana in terms of jobs?

A No, we did not.

MR. SHERIDAN: Nothing further.

HEARINGS EXAMINER: That's all the cross-examination you're going to get, sir; I hope you're not disappointed, but your statement will go in the record and go to the board members.

WITNESS: Thank you Mr. Davis, it was nice meeting you.

(WITNESS EXCUSED)

MR. BELLINGHAM: Sir, before proceeding, I think we have just a couple of procedural matters. First of all, I think Mr. Ross has some change in previous testimony of Paul Schmeckel, after which we would like to rest our case.

HEARINGS EXAMINER: Go ahead.

MR. ROSS: I have been advised by Paul Schmeckel that figures on pages 6 and 7 of his written statement previously submitted should be changed. The reason for the change is the figures on pages 6 and 7, which relate to acres of land disturbed and acres of land reclaimed, did not include some of the areas which are associated with the disturbance, such as railroad tracks. Therefore, at this time I wish to correct on page 6 at line 17 where it reads 1,140, it should read 1,852 and page 6, line 20 where it reads 706, it should read 1,172. On page 7 at line 5 where his previous statement read 412, it should read 899 and also on page 7, line 5 where it previously read 706, it should read 1,172.

HEARINGS EXAMINER: Very well. I guess we'll permit the change in the record so he doesn't have to come back to clarify it. I don't think there would be any extensive cross on it. Is there anything else now before we continue?

MR. BELLINGHAM: The applicants at this time rest our case.

WILLIAM A. BREWER, having been previously called as a witness by the Department of Natural Resources and Conservation, and having been previously sworn upon his oath, resumed the witness chair for the continuation of his examination and testimony.

CONTINUATION OF EXAMINATION OF WILLIAM A. BREWER

Cross, by Applicants

By Mr. Bellingham (continuing):

Q Dr. Brewer, when were you called into this case?

A To the best of my recollection it was about November -- I'd have to confirm this with counsel; I simply have forgotten the first contact on it.

Q November of what?

A Last year.

Q That would be November of 1975?

A Yes.

Q And who was your contact with at that time?

A Mr. Shenker.

Q You had no previous contacts with the Department of Natural Resources of the state of Montana?

A I had contact with Dr. Tsao, for example, in the context of general state energy matters, but not in relation to this case.

Q And I assume then that you did not contribute any statistics or have any impact upon the Environmental Impact Statement prepared by the Department of Natural Resources?

A No, sir, that was furnished to me when I began work on the case.

Q And I assume that you are being paid on an hourly rate, as most experts are?

A Daily rate, yes, sir.

Q Daily rate?

A Yes, sir.

Q What is your daily rate, if I may ask?

A It depends on the contractural arrangement; in this case it's $200.00 a day.

Q I have just a couple more questions, Doctor. You cite recent statistics in your prepared statement; are you aware of statistics put out by the Northwest Power Pool? You know what we're talking about, don't you?

A Yes, sir. Whether it's Northwest Power Pool or any other affiliated organization, I attempt to go back to the original source, whether it's PNUCC or Bonneville Power Administration.

Q You're familiar with the fact that Northwest Power Pool does include the five applicants in this case; are you aware of that?

A I'm not aware of what they've said in this case; it does not surprise me.

Q Are you aware of the fact that the Northwest Power Pool figures for January of 1975 show a load of 17,643 average megawatts normalized for temperature, and the comparative figures for the January, 1976 period normalized for temperature were 18,840 megawatts, an increase of approximately 6.8 percent over the previous year's figure?

A Are we talking about firm energy or total energy?

Q We're talking about total?

A I have not used total energy because total includes secondary, surplus power, power delivered in and out of the region; it's not only a difficult accounting problem, I don't think it's really the basis of utility planning that we're talking about here.

Q Well, you were not aware of those statistics, however?

A Those particular numbers?

Q Yes.

A They certainly seem reasonable.

Q Now, when we go back to your method of forecasting you call sectorial methods, what you basically are doing is you are separating customers into classes and so forth; isn't that right?

A That's one of the entries into the system, only one.

Q And you are familiar with the fact that most utilities divide their customers into classes insofar as load forecasting is concerned, are you not?

A Yes, I'm aware that they use generally a different method of dividing customers. In my experience it's been generally related to the method of billing and the rate schedule that's applied.

Q But you are not familiar with the way the applicants in this case divide their customers into classes?

A As I testified previously, I am not familiar with the forecasting method of the applicants.

Q And of course different utilities, because of different locations and different classes of customers and so forth, separate their customers into classes in a different approach and different manner; I'm sure you've heard of that, haven't you?

A I'm sure the method is different from the method that we have used here.

Q It wouldn't surprise you, would it, if I were to tell you that Puget Sound Power and Light Company had a 7.4 percent growth rate in 1975 during which time it eliminated all promotion advertising and all promotions of every kind, and advocated strong, conservation practices; would that surprise you?

A I'll accept that if it's the statement of Puget. I see no reason to be surprised or otherwise concerned with it.

MR. BELLINGHAM: No further questions.

Redirect, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Dr. Brewer, Mr. Bellingham asked you some questions on cross regarding the statement, "There was a need to stem energy usage." You gave some testimony with respect to the marginal costs associated with greater production of energy potential. Why is it, sir, in your opinion, necessary that this region or the United States in general stem the rate of increased energy usage?

A My answer to that applies specifically to the electrical utility business, but it also applies to the energy business in general. It is the most highly capital intensive sector in our economy. Now, we are, I think, as a country facing a shortage of needed capital over the decade and the generations to come. If the energy industries make heavy demands upon the amount of capital available, there will be less money available for other equally worthwhile, perhaps more desirable, projects and developments, and I think that's the underlying cause.

Q With increased requirements for capital, what has industry customarily done with respect to the work force?

A This has a very long history of examination in our generation. The general trend has been to substitute energy and machines for people and jobs. We called it automation ten years ago; now we call it the conflict between labor intensive and energy intensive industries. It's all part of the same historical pattern.

Q Mr. Bellingham also asked you some questions regarding a comparison between the growth of our gross national product and increased energy usage and you answered, I believe, that the two paralleled one another. Does that mean, in your opinion, that there is a correlation between GNP growth and increased energy usage?

A No, I do not believe that myself and in corroboration I would cite studies such as the Energy Policy Project of the Ford Foundation, a rather massive study which is now being fully reported, which strongly suggests, and I concur in this, that there is an excellent possibility now to "decouple" energy growth and growth in the GNP, and the Ford policy study is not the only one of these; there are quite a number in the literature.

Q Are there any foreign analogies to the situation which Mr. Bellingham hypothecated to you?

A Yes, I think some of the most fairly studied, particularly by the Federal Energy Administration and other federal agencies, have been western European countries -- I believe I touched on this in previous testimony -- that have equal or higher per capita incomes, equal or higher standards of living as ordinarily measured in terms of amenities and services, and equally vibrant economies, in some cases doing better than ours right now. And yet, some of these countries have managed to get by with much less energy per unit of consumption, or unit of output. West Germany is the largest single example, but I would say Switzerland is probably the one which has come closest to a moderate, almost zero, energy growth while still maintaining a solid economy and high standard of amenities for its people.

Q Is the same true for Sweden?

A Sweden is another of those countries very much in the same class.

Q Mr. Bellingham also asked you of the possibility of energy shortages in a time period following the expiration of the next two to three years, and I think you testified in response to that question that, "Yes, there is a possibility of spot shortages"; am I correct?

A Yes, sir.

Q Were your answers based upon your studies or did you assume facts from other studies with which you were not involved?

A I think I can expand on my previous answer -- and also that's a good question -- by saying that if the forecasts of electrical load growth in the Pacific Northwest are identical to or extremely close to those that are being forecast, then the analytical techniques used do, in fact, predict shortages in certain years. However, my calculations and the forecast which I think is closer to the present situation, do not forecast such shortages. Also in relation to spot shortages, by this I mean shortages of a very limited nature which can primarily be taken care of with the commitment of reserves, exchanges, the ordinary methods that utilities use to take care of a brushfire situation.

Q And based upon your analysis of the West Group northwest energy requirements, would you say it is more probable or only possible that there would be spot shortages?

A I would say that it is not probable; it is only possible, and I do not think that it's highly possible over the period of time that you're talking about.

Q And your answers were in the context of energy demands as opposed to peak demands, were they not?

A Yes, I tried to be extremely consistent on this in the technical sense. Most people agree that the big problem for the Pacific Northwest is not peaking, and I have not paid any attention to it in my analyses.

Q One other area that Mr. Bellingham inquired of you was the possibility that if the utilities are unable to provide energy to their customers, they're in trouble. It's also true that if they don't provide dividends to their investors, they're in trouble also, isn't it?

A Absolutely. This is the specter that hangs over any business enterprise, but it is an extremely serious one in the case of utilities.

Q Are you aware of the increase in the dividends paid by Montana Power Company this year for last year?

A I'm not aware of the specific increase for Montana Power; I am aware of increases for some of the applicant companies.

Q They are increasing, are they not?

MR. SHERIDAN: I have nothing further.

HEARINGS EXAMINER: Mr. Bellingham?

Re-cross, by Applicants

By Mr. Bellingham:

Q We've talked over, and you've mentioned, laws and regulations that say that utility companies must provide services to their customers; do you recall that?

A Is that in reference to the responsibility clause?

Q Right.

A Yes, sir.

Q And you say now, of course, that they also have a responsibility to provide dividends to their stockholders?

A Yes, sir.

Q There is no law, though, that says they have to provide dividends to their stockholders, is there?

A There is no law that requires that, but I believe the general examination of policies of regulatory bodies would bear out that they have not determined that it's in the public interest to let any utility go under.

Q Well, that's understandable, isn't it?

A It is to me.

Q But there certainly is no law that says that they have to provide these dividends?

A No, sir, there is not, to my knowledge.

Q When you talk about a correlation between increased gross national product and the increase in the energy use, you say that you don't see that there is any correlation, and you realize, of course, that your opinion is your opinion only, isn't it?

A Well, I hope so.

Q And certainly there are others in the industry that for many years have correlated the increases between energy use and gross national product, haven't they?

A Correlation is a technical term, Mr. Bellingham.

Q Yes, sir, you used it, didn't you?

A Yes, and I say that I do not find a correlation in the technical sense. Two correlated trends or functions would imply that one has a direct linkage to the other, and I mean a direct statistical linkage and I do not find that in my analysis.

Q Fine, you do not, but there are many others that do; isn't that right?

A I'm willing to accept that as a true statement.

Q That's right, and there have been studies made concerning this point, have there not?

A I have seen in the case at hand graphic displays in which an upward march of GNP and other economic indicators are related to an upward march of electrical energy consumption. Whether or not that constitutes a technical analysis and a correlation in the sense that we're using here, I don't know; I strongly suspect that no such correlation has been established, that it's an intuitive statement.

Q Well, I think you've previously indicated that there are certainly a lot of other people engaged in this business that you are that disagree with your approach as far as the GNP and the energy use as having no correlation between them. I think you've indicated this already?

A Yes, there's no perfect agreement; that's why we're here.

Q Fine. Now as far as these spot shortages in the northwest and everything, you addressed yourself once again to the Pacific Northwest, have you not?

A Yes, sir.

Q And as far as shortages concerning the five applicants in this case, you are not aware of what their forecasts are as far as future shortages are concerned, are you?

A In my previous testimony I stated I had not studied the five applicant companies apart from the Pacific Northwest overall; that was not in the scope of my assignment from counsel.

MR. BELLINGHAM: No further questions.

MR. SHERIDAN: I have nothing further; thank you, Doctor.

HEARINGS EXAMINER: You are excused, sir.

(WITNESS EXCUSED)

HEARINGS EXAMINER: Gentlemen, we have a rancher who just came in from Melville.

JAMES A HANSON, appearing as a public witness, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

(THE WRITTEN DIRECT TESTIMONY OF MR. JAMES A. HANSON WAS DIRECTED TO BE INSERTED AT THIS POINT.)

James Hanson, rancher
Melville, Mt.

Reasons why I'm here.

1. I'm here today strictly on my own. I haven't been asked, paid or coached by Montana Power or anyone else. I'm here simply to make a few statements and present a few facts as I see them.

2. Because these proposed lines, if they are approved, could very well cross my land, or come within a few miles of it. I feel I have reason to express my feelings on it.

3. I happen to be a taxpayer in this state and I don't believe I've been getting my money's worth at these hearings. The hearings should have been completed last year.

Now, for some of the reasons I believe these lines should be approved. This appears to be a poor time to hold back power development, a time when Montana must develop more of its own power and also when we are losing our gas + oil supplies from Canada. We farmers + ranchers in the U.S. are feeding a larger share of the world every year and we must have more power to do it. One of the major increases in the use of electricity for agriculture is irrigation.

I question some things in the environmental impact statement about these power lines. It mentions the effects on crop spraying. With only four towers per mile this would be much less a problem than normal distribution lines. A minimum height of 37' would give plenty clearance.

The acreage taken out of production permanently would amount to only about 7/10 A. per mi. The rest of the right of way would still be used as pasture or farmland. Any roads or trails used or built for construction should be reseeded, and can be. If chemicals were used to control weeds along the right of way it would cause no more problems than in fields. This statement even mentions pollution from equipment in constructing the lines. This would hardly be measurable in comparison to shipping this much coal on the railroad, and as for shipping the coal west by rail, I would much rather have a power line across my place than a railroad, and just how much coal could be shipped on the present rail lines. If a new railroad had to be built some landowners would have to lose some land and much more than for a power line.

When your Energy Planning Div. was drafting this Impact Statement why didn't they go to where some of these lines now exist and get some real facts instead of drawing conclusions from a page of books. This to me looks more than just a little bit ridiculous.

The radical environmentilists shouldn't have too much to complain about as this line would seldom come close to ~~a road~~ hiways except where they cross them. Some of these people who can't stand the sight of a power line are here 170 yrs too late. They should have come with Lewis & Clark. Those who were spreading rumors about how dangerous these lines would be are, as far as I'm concerned in the same class.

HEARINGS EXAMINER: Mr. Hanson, you advised me that you wanted to amplify on your written statement. You may go ahead.

Oral supplement to written statement, by Mr. Hanson:

In addition to what I have down there, I just have a few more comments that I noted on the way up here. I have noticed lately in the news that the opponents to this --

MR. SHERIDAN: I object to this as being hearsay.

HEARINGS EXAMINER: Overruled.

The opponents to this project are saying that this is going to set a precedent, and I wonder why it should set a precedent if Colstrip 3 and 4 is approved. If I let somebody hunt on my land -- let one guy hunt, it doesn't mean I need to let everybody else hunt. Maybe we should use a little bit more common sense; I think that's one thing we've been lacking in government and a lot of other things lately. Most of what I have in this written testimony concerns power lines because that's what would concern me personally. One thing I didn't note in there about the lines is, what cleaner way could you ever find to transmit this much energy, move this much energy? I don't see any other way possible to move that much energy with so little pollution, and that's one thing that concerns everybody today. Another thing is that this project is proposed by private enterprise and private enterprise is what this country is built on and what it has existed on for the last 200 years, and we're going to have to support that private enterprise because if we don't in cases like this, and we keep piddling around with hearings and government propaganda and bureaucratic nonsense, we're going to end up and get into a jam, in this case possibly years later where we could need that power, and if we don't do it ourselves, and wait until the federal government gets in here and does it for us, then what say are we going to have about it? You won't have a lot of say. One last comment I've got, but it's been tossed back and forth, I think, from both sides that I've heard, is that the news media was slanted and also that the impact statement was slanted one way or another. The other night, I shouldn't mention names here, but our congressman from the eastern district came out -- I don't know how many of you heard this; I could hardly believe my ears but I heard it myself. He came out in favor of Colstrip 3 and 4 if it met pollution standards. This was on the news last Thursday evening, but I never heard it again. I listened to the news the next day and I never heard a mention of it again, but something comes out, say in these hearings, something that the news media can pick up, and opposition to 3 and 4 or power lines, you hear it on the news all the next day, every newscast. So that to me looks like it is slanted. As I said in my testimony, I'm a rancher from Melville and I'll say again that I wasn't asked to come here by anybody; I'm here on my own because the power lines could very well come across my place if they are approved, and that's one reason that I feel that I had reason to be here. Thank you.

HEARINGS EXAMINER: Thank you, Mr. Hanson. You may cross-examine, Mr. Sheridan.

EXAMINATION OF JAMES A. HANSON

Cross, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q How far from Forsyth do you live, Mr. Hanson?

A Oh, I couldn't tell you exactly in miles from Forsyth; I'm 60 air miles out of Billings, northwest.

Q That's how far from Colstrip?

A I'd say between 100 and 150 miles.

Q So you don't have any of your stock in the vicinity of that plant, do you?

A No, I don't have any concern with --

Q You don't own any land there or you don't have any animals grazing. Can you tell me what pollutants are being emitted from that plant?

A No, I can't.

Q Have you read any of the impact statements, either by the applicants, the power companies, or by the Department of Natural Resources?

A I didn't read any of the statements in concern to the plants; I was concerned with the power lines, and that's what I had in my statement.

Q And this is the first time since the hearing commenced that you've been here; is that right?

A Yes, that's correct.

Q And you grant that there is a right for both sides to be heard in a hearing of this nature?

A Oh, certainly.

Q Do you know that the opponent public witnesses haven't even appeared yet?

A No, I didn't know that, sir.

Q Well, don't you think we ought to allow them that opportunity rather than, as you say, dillydally around?

A Rather than what?

Q As you say, dillydally around. Don't you think that maybe the opponents ought to be able to get up here and testify, of the public?

A Certainly they should, but I think the hearings could have been speeded up last year.

Q Well, sir, have you been here at any one time since the commencement of these hearings to find out what's been going on?

A No, I haven't been to the hearings.

MR. SHERIDAN: I have nothing further.

HEARINGS EXAMINER: Very well, sir, thank you for coming. You are excused. Your testimony will go to the board together with the other testimony.

(WITNESS EXCUSED)

HEARINGS EXAMINER: All right, your next witness?

MR. SHERIDAN: We will offer through Dr. Brewer's testimony Exhibits 110 through 115.

HEARINGS EXAMINER: Very well, your motion to strike is denied and the exhibits will be admitted.

MR. BELLINGHAM: May I ask whether or not we can obtain the bibliography that apparently has been omitted from Exhibit number --

HEARINGS EXAMINER: I think that's a reasonable request.

MR. SHERIDAN: Sure.

HEARINGS EXAMINER: And any other omissions that you mentioned in there, I think you'd be happy to supply if they're there, wouldn't you?

MR. SHERIDAN: Sure.

MR. BELLINGHAM: Can we have any idea of when we might get these? Do you have them in your hip pocket, Dr. Brewer?

MR. SHERIDAN: If you're planning that on the record, Mr. Bellingham, I object. It's a cheap shot.

HEARINGS EXAMINER: I didn't hear it; it will be stricken, whatever it was.

MR. SHERIDAN: Dr. Brewer will try and round it up and get it here within ten days to two weeks.

HEARINGS EXAMINER: It won't help much for this hearing.

MR. BELLINGHAM: Ten days to two weeks is a little indefinite; we'd like to get them within the next week; surely it shouldn't take him that long to go back and send them to us.

MR. SHERIDAN: You asked. That was the answer I received.

MR. BELLINGHAM: When we're asked for material, we're supposed to get it yesterday.

MR. SHERIDAN: Well, Mr. Bellingham, there's some material that we asked you to produce in February of 1975; we haven't got it yet.

MR. BELLINGHAM: If you haven't by now, you've got tons of other material; I'm sure of that.

MR. SHERIDAN: Well, we asked for certain things; we wanted what we asked for, not what you decide is proper to give us. The next department witness will be Dr. Alan Morris.

MR. BELLINGHAM: Well, are we going to have anything more definite than ten to fourteen days, or is that it?

HEARINGS EXAMINER: Well, he can do the best he can; if he doesn't get it, we'll hold a recess in the hearing until he gets here.

DR. ALAN D. MORRIS, called as a witness by the Department of Natural Resources and Conservation, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

(THE WRITTEN DIRECT TESTIMONY OF DR. ALAN D. MORRIS WAS DIRECTED TO BE INSERTED AT THIS POINT.)

STATEMENT OF TESTIMONY

OF

DR. ALAN D. MORRIS

I am Alan D. Morris. I received my professional education from The Johns Hopkins University, graduating with a Bachelor of Engineering in 1951 and a Doctorate in Engineering in 1955. I am a Registered Professional Engineer (RPE) in the State of Maryland and in the District of Columbia. I am a member of the following professional societies, among others: Sigma Xi (The Scientific Research Society of North America), The New York Academy of Science, American Association for the Advancement of Science (AAAS), Tau Beta Pi (Honorary Engineering Society), International Society for Technology Assessment, and the American Association of Small Research Companies. I have been appointed to serve as one of the sixty representatives of the nation to the AAAS-ABA (American Association for the Advancement of Science/American Bar Association) National Conference for Scientists and Lawyers.

From 1951 to 1955 I was a Research Associate, Institute for Cooperative Research, the Johns Hopkins University, Baltimore, Maryland; from 1955 to 1958, I served as LT(jg), U.S. Navy, Aeronautical Engineering Officer; from 1958 to 1961, I was a Research Scientist, Operations Research, Inc., Silver Spring, Maryland; from 1961 to 1969, I served as Associate Professor and Director of Operations Research Programs, American University, Washington, D.C. From 1969 to the present, I have been a principal of Morris and Ward, Consulting Engineers, Washington, D.C.

A. INTRODUCTION

1. Public concern over the effects of burning coal is centuries old. In 1239, a charter was granted to the inhabitants of Newcastle to dig for coal. Large quantities of coal were brought by sea from Newcastle to London and the coal was known as sea-coal. By 1281 considerable trade had been built up and during the next ten years so much coal was being used for manufacture that in 1292 Parliament petitioned King Edward I to prohibit the use of coal in London. It was thought that the fumes corrupted the air and many people were offended at the "sulpherous smoke and saver of the firing."

The King complied, and when the law was not obeyed a commission was issued to ascertain who burned sea-coal within "the city and its neighborhood, and to punish them first by a fine, and second by demolition of their furnaces." One man was tried, convicted and executed for the crime of burning sea-coal in London, in part because there was a danger to lives and property by using coal in wooden buldings, and an example had to be made.

2. Today, technology is available so that coal burning power plants can be fitted with scrubbing equipment to remove the major portion of the "sulpherous smoke" and the other pollution products that result from the burning of coal. Even so, it is fully appropriate to examine, in all aspects, an application for the siting of a coal-burning power plant at a particular location. In the present case, the Montana State Department of Natural Resources and Conservation (DNRC) has carefully reviewed the application for the siting of

1400 megawatt (MW) facilities at Colstrip, Montana, weighing the risks, benefits and utilities attendant to the construction and operation of the proposed generating facilities.

In their final Environmental Impact Statement on the proposed 1400 MW generating facilities, the DNRC recommended to the Board of Natural Resources and Conservation that the application for a Certificate of Environmental Compatibility and Public Need for the generating facilities be denied. Among the many reasons given by the DNRC for denial of the certificate there was stated the key point that the power to be generated by the proposed facilities was not needed in the state of Montana. Further, that of the power to be generated by the 700 MW facilities now under construction at Colstrip (Units 1 and 2), only 350 MW could be used within the state, and the remaining 350 MW would be exported.

3. It is well known that the production of oil and gas in the United States is declining. In our nation's effort to achieve energy independence, we must turn to our great coal reserves to meet our energy needs until the time that advanced energy means, such as nuclear, solar and geothermal, are available in sufficient magnitude. In the year 2000 the consumption of coal is projected to be 1,560 million tons, while 557 million tons were consumed in 1974. This corresponds to an increase in coal consumption by a factor of almost three.

4. The State of Montana is willing to make a significant energy contribution to the nation. The production of strip-mined coal is increasing each year. A major portion of this coal production is exported from the state. The state is

absorbing, and will continue to absorb, the social, economic and environmental impacts associated with the production of coal. Strip-mining in the West and in other parts of the country has proved to have catastrophic effects on the land. The state will have to make great efforts to ensure that now and in the future the strip-mined land will be reclaimed and restored to its original capacity. Since the state is willing to export its coal and since the state has no need for the power that would be generated by the proposed 1400 MW facilities they should be located at a load demand center and not at a mine-mouth source center at Colstrip. This proposition will be examined in my testimony from another and most basic point of view, that of most efficient utilization of our precious energy resources.

B. TECHNOLOGY ASSESSMENT

5. On December 11, 1975, the Environmental Protection Agency Administrator, Russell E. Train, announced that although the American society is willing to accept a reasonable amount of energy-related and other developments, it is unwilling to repeat the errors of the past. Mr. Train further announced that any thought of the West as a "national sacrifice area" should be forgotten, Such a concept is as unnecessary as it is unacceptable. If anyone should be making sacrifices, it should be our society as a whole by cutting down waste, tightening our belts and making a national commitment to energy conservation. As Administrator Train continued, and as it clearly should be seen that it is true, when environmentalists call for long-range, comprehensive planning as an essential

framework for intelligent energy development, let us stop viewing such a policy as an obstacle and accept the fact that we cannot afford not to do such planning. Citizen participation at all levels of decision-making is an essential ingredient to the development of energy programs that are responsive to the needs and concerns of our society as a whole.

6. To implement the program for action, as expressed by the EPA through Mr. Train, above, for example, modern society needs a methodology for evaluating the potential impact of our new technological developments before large investments have been made in them. Technology assessment is a relatively new science that fulfills this need. It provides a mechanism whereby the broad social effects of exploiting or restricting a technological development can be considered and effectively expressed.

Although the methods and the mechanisms for technology assessment are in their infancy, useful lessons were drawn from the rejection by Congress in 1971 of the U.S. Supersonic Transport (SST) Program. The British and the French continued on their joint SST program, the Concorde, and right now the SST conflict has re-emerged because of the British-French request for landing rights in the United States. The North Atlantic run is absolutely necessary for the economic survival of the Concorde program. Spurred by the need for technology assessment support in making its decisions, Congress established an Office of Technology Assessment "to provide a method for identifying, assessing, publicizing and dealing with the implications and effects of applied research and technology."

Technology assessments are taking place in many areas, as, for example:

a) The proposed plan of Minnegasio to strip-mine the vast peat bogs of northern Minnesota and to use the peat as fuel to be converted to methane in a synthetic natural gas plant.

b) Technological innovations, such as implants of the hormone mimic DES, to improve the efficiency with which cattle convert their feed to added poundage.

c) The use of powerful herbicides such as 2,4,5-T, the Agent Orange of Vietnam, to rid national forests of unwanted trees, to kill brush along highways, and to keep utility power lines clear.

d) The American Electric Power Company's planned pumped-storage dam system on the New River at the Virginia-North Carolina border (References 3 and 4).

7. The hearings so far held on the proposed 1400 MW generating facilities of Colstrip are in themselves a technology assessment. Evidence and testimony were given to assess the risks and the benefits of the new proposed facilities. Many first-order and some higher-order effects were presented and discussed. For example, here is a short, representative list:

a) First-Order Effects

1) The facilities will burn "X" amount of coal, use "Y" amount of water, and produce "Z" amount of emissions.

2) The facilities will provide "M" amount of jobs

and "N" amount of tax base.

3) The stack height will produce a plume of "P" distribution characteristic.

b) Second-Order Effects

1) The facilities will produce "Q" amount of socio-economic impact in Rosebud County.

2) There will be "R" amount of damage to vegetation and crops.

3) There will be "S" morbidity and "T" mortality caused by the emissions of sulfur oxides and particulate matter in "U" time frame.

Many of the long-term effects of the facilities are not well known or are only suggested. For example, nitrosamines, a well-established class of animal carcinogens, are suspected as a route to explain the significant correlation found between atmospheric levels of nitrogen dioxide and urban cancers. Neither nitrogen dioxide (NO_2) nor nitric oxide (NO) have been demonstrated to cause cancer. However, when combined with water under certain conditions, both NO and NO_2 can become nitrous acid, which then combines with amines to form nitrosamines. Amines are produced in the decomposition of proteins and are found almost anywhere. Nitrous acid is formed from NO and NO_2, both of which are products of coal combustion. Control of these so-called "precursor" chemicals, to prevent spontaneous formation of nitrosamines in the environment, could pose the need for new regulatory standards for the public utilities.

There is a suspected relationship between radioactivity in tobacco smoke and cancer in smokers. Radioactive particles are also released from coal-fired power plants. Research yet unpublished shows that certain isotopes are substantially enriched in coal-fired effluent. Depending on the solubility and concentration of these isotopes on particles of respirable size, they may contribute to increase cancer risks among those chronically exposed to them. Also, there is new evidence that air pollution from primary emission sources is transported by prevailing winds over great distances.

8. A basic principle of decision-making should be to maintain the greatest practicable latitude for future action. Other things being equal, the technological projects that should be favored are the ones that leave maximum room for maneuver. The reversibility of an action should thus be counted as a major benefit, its irreversibility as a major cost. Benjamin Franklin who, among all his great accomplishments, invented the cast-iron stove named after him, was concerned about energy conservation and reversibility. In an essay on the common cold, he stated:

> "The mentioning of these northern nations (Swedes, Danes, Russians) puts me in mind of a considerable PUBLIC ADVANTAGE that may arise from the general use of these stoves. It is observable, that, though these countries have been well inhabited for many ages, wood is still their fuel, and yet at no very great price; which could have been, if they had not universally used stoves, but consumed it as we do in great quantities by open fires. By help of this saving inventionour wood may grow as fast as we consume it, and our posterity may warm themselves at a moderate rate, without being obliged to fetch their fuel over the Atlantic; as, if pit-coal should not here be discovered (which is an uncertainty) they must necessarily do." (Reference 5, pp. 76-77)

9. If the proposed 1400 MW facilities are sited at Colstrip, and improperly so, that action will be irreversible. The facilities will have a useful lifetime of at least 30 years. Long before that period passes, new technology for more efficient and cleaner utilization of coal will become available. These new technologies include fluidized-bed boilers, low and high BTU syngas conversion, MHD conversion with bottoming and topping cycles, and synfuel conversion. Montana has its own MHD development institute at Butte. The Montana MHD facility will perform engineering development and proof testing of prototype MHD components, and it will study the interactions associated with the integrated operation of key MHD components and subsystems.

Although the coal mined at Colstrip is now shipped by rail to load demand centers, in the future it may be shipped by means of efficient, long-distance slurry pipelines. If a synfuel or syngas conversion facility were to be eventually sited at Colstrip, the fuels then could be transported to demand centers by efficient pipelines.

C. Energy Intensiveness of Energy Transport

10. When Benjamin Franklin thought of means for efficient energy utilization, he was thinking of wood as fuel, not coal. Trees can be thought of as a renewable resource, a crop to be harvested and replanted. Coal, like wood, is a form of energy concentrated from the sun. But coal, unlike wood, was formed over eons of time. It is not a renewable resource; once mined and burned, it is gone.

Coal is part of our "terrestrial dowry." A given lump of coal can be burned only once. There is of course the same amount of energy in the heat, smoke and ashes as there was in the lump of coal, but the energy bound up in the combustible products is dissipated and the process cannot be reversed. Our terrestrial dowry of fuel, minerals, fertile land, clear water and clean skies is seemingly unlimited but is in fact quite finite. Unless we intend to leave our posterity with nothing but dirty air, fouled waters and spoiled lands, we best take extreme care to utilize our energy resources in the most efficient and environmentally correct manner.

11. If the 1400 MW facilities were to be sited at Colstrip, then the electrical energy generated would be transported to a load demand center by 500 KV transmission lines. On the other hand, if the same facilities were to be sited at the load demand center, then the coal to fuel the facilities could be transported by unit trains operating from Colstrip. Each mode of energy transport itself requires energy to make the transport. In the case of the transmission line, there is energy lost along the transmission line; less energy exits the transmission line at the terminus than the energy placed on the line at the generating facility. In the case of rail-haul of coal, fuel is consumed by the locomotives. The energy intensiveness of the energy transport, in each case, would be calculated as follows:

$$\text{Electrical:} \quad \frac{\text{Energy Lost on Transmission Line}}{\text{Energy Placed on Line at Generating Facility}}$$

$$\text{Unit Train:} \quad \frac{\text{Fuel Energy (Round Trip)}}{\text{Energy of Coal Hauled on Train}}$$

The unit of energy used in these relationships is commonly taken as BTU's. The fractions that result may be multiplied by 100 to obtain the energy intensiveness of energy transport as a percentage. The percentage figures for the two modes of energy transport may then be compared; the mode with lowest percentage of energy intensiveness is taken the most efficient mode for transport of energy. Taking a world-view of our terrestrial dowry of energy resources as finite and worthy of optimum utilization under all circumstances, we would elect the mode of energy transport that is most efficient.

12. Until recently, almost all engineering calculations for comparison of different modes of energy transport were done on a cost-economic basis. Terms like "annualized," "levelized" and "optimized" are commonly found among these textbook calculations. A very recent example of a cost-economic comparison of energy transport by electrical transmission, coal slurry pipeline, rail-barge and all-rail is found in Reference 6, pp. 58-59. No mention there is made of comparison of energy intensiveness for the four modes of energy transport; costs only were considered. This is wrong. All the results in the paper will be changed by changes in the rate of inflation, investment costs, land costs, labor costs, etc. Costs for energy are going up every day; we are now closer to paying the true costs of energy. For too long, our entire economy has been based on cheap energy. That is why our automobiles, appliances, houses, industries and energy conversion techniques are of grossly inefficient energy design. The only absolute

is not the cost-economics of energy but is energy itself. We are now painfully aware that we must utilize energy in the most efficient manner possible.

13. The technology assessment of the proposed 1400 MW facilities at Colstrip must include a consideration of the energy intensiveness of energy transport. If it is more energy efficient to transport energy by shipping coal from Colstrip than by sending electrical energy over transmission lines, then the 1400 MW facilities should not be placed at Colstrip but should instead be constructed at a load-demand center.

14. There are two very important and comprehensive studies on coal utilization. The studies are also very well known, having been the subject of Senate hearings and review (for example, see Reference 7). The studies are:

a) Clean Coal Energy: Source-to-Use Economics, Phase I Report, Bechtel Corporation, P.O. Box 3965, San Francisco, California, 94119, April, 1975. Prepared for Energy Research and Development Administration, Washington, D.C., 20545. Contract No. E(49-18)-1552. NTIS No. FE-1552-T1: (Bechtel)

b) The Coal Future: Economic and Technological Analysis of Initiatives and Innovations to Secure Fuel Supply Independence, Center for Advanced Computation, University of Illinois at Urbana-Champaign, Urbana, Illinois, 61801, May, 1975. CAC Document No. 163, NSF Grant No. GI-3582 (A)1. (CAC)

On the question raised in paragraph 13 of this testimony, the reports are in complete agreement. In Section 2.3.4 Electric Transmission, the Bechtel report states:

> "Transmission line losses can be substantial, amounting to as much as 10 percent of the line loading per 100 circuit miles of transmission."

In Table 4 of the CAC report, pp. IV-18, 19, there are given the resource requirements for unit train shipment of 25 million tons of coal per year over routes of different lengths. Data taken from that Table are as follows:

Miles One-Way:	500	250
Fuel Energy As A Percent of Coal Energy Delivered	0.79%	0.35%

In Section 2.6.2 Preliminary Conclusions of the Bechtel report, there is the conclusion:

> "To maximize efficiency or energy output, convert at the demand center."

From these two current and major studies, the obvious conclusion which I share is that it is far more energy efficient to locate the 1400 MW facilities at a load demand center and to transport the coal by unit train from the source mine to the generating facility.

D. The Future

15. Figure 1 (Exhibit 101) presents an excellent picture of U.S. energy flow patterns. It can be easily seen that of all the energy supplied from resouces into our system one-half is wasted. The electrical energy flow pattern is shown at the top of Figure 1, (Exhibit 101). There are

15.1 supply input units; only 5.3 output units available for end uses. This amounts to a conversion efficiency of:

$$\frac{5.3}{15.1} \times 100 = 35\%$$

The remaining 9.8 units are lost in conversion and over the electrical transmission lines. Because today a coal-burning plant must be fitted with flue gas desulfurization (FGD) equipment (Figure 1, (Exhibit 101) omits such requirements), the power required to operate an FGD system will lower the conversion efficiency by amounts of four to seven percent (Bechtel, p. 2-52). Thus, the conventional style facilities planned for Colstrip would only have a conversion efficiency of about 30%.

Again, from the conclusions of the Bechtel report, Section 2.6.2, coal conversion processes are compared:

Coal Liquefaction - High Efficiency
Coal Gasification - Moderate Efficiency
Coal-Fired Power Plant - Low Efficiency

Thus, if options are left open and the proposed 1400 MW conventional power plant facilties are not sited at Colstrip, new, and more energy-efficient processes can be employed for a power plant to be sited at Colstrip, or elsewhere.

16. Bechtel Corporation is also the scientific and engineering firm participating in Energy Transportation Systems, Incorporated (ETSI), the company that proposes to build a coal slurry pipeline from Wyoming to Arkansas. ETSI's address is Bechtel's address - P. O. Box 3965, San Francisco, California, 94119. An ETSI publication, Slurry Pipelines - Innovation in

Energy Transportation, is reprinted in the hearings record on Coal Slurry Pipelines, Subcommittee on Minerals, Materials and Fuels, of the Committee on Interior and Insular Affairs, U.S. Senate, 93rd Congress, June 11, 1974, pp. 65-82. The revised edition of that publication was issued in October, 1975.

17. In the ETSI report, there is shown the advantage held in water utilization by the coal slurry pipeline (p. 7):

Water Requirements (Gallons Water 1 Million BTU Delivered)	
Minemouth Power Plant	100
Coal Conversion	10-30
Coal Slurry	12

Further advantages offered by the coal slurry pipeline are as follows, according to that same report:

There are three basic ways in which coal energy for utility use can be transferred from the sparsely populated western states to the major urban centers where it is needed. They are:

1) Generate electricity at the mine, then send the electrical energy to the consumer via extra high voltage (EVH) transmission lines.

2) Transport the coal itself via rail.

3) Transport the coal itself via slurry pipeline.

Among these alternatives it is concluded that slurry pipelines offer the greatest cost and environmental advantages.

As Bechtel has observed, and in my view, beyond operating conditions, however, are the basic issues of community development in the western states. Mining and pipeline operations are capital intensive and thus involve relatively small operating crews. But in constructing mine-mouth power plants with large work forces - - or even with relatively small increases in the work forces, in the sparsely populated western states there should be expected a serious impact on local communities and their style of life.

The slurry transportation concept provides the Western states with an opportunity to plan their development at a more measured pace. Other new and developing technologies offer the same advantage without the scourge of making irreversible errors in judgment. Slurry pipelines, for example, can make western coal available quickly elsewhere in the nation, providing more time for each state to plan the long-term development of an energy complex best suited to its own situation. Technology, energy intensiveness, conservation and environmental concern add up to the choice of an option for developing coal reserves without necessarily siting the total energy plant in the area where the coal happens to exist. That fortuitous fact, after all, is not the result of planning, policy or judgment. This testimony concludes, therefore, that energy planning, efficient coal utilization and the judgment of technology all oppose the siting of the proposed 1400 MW facilities at Colstrip.

LIST OF REFERENCES

1. H. Brooks and R. Bowers, The Assessment of Technology, Scientific American, Vol. 222, No. 2, February, 1970.

2. D. Zwerdling, Spraying Dangers in the Air, Washington Post, 25 January 1976, p. F3

3. A. Scott, Power Struggle on an Ancient River, Washington Post, 19 January 1976, p. A1.

4. American Electric Power Company, The Truth About The Blue Ridge Project (Advertisement), Washington Post, 20 January 1976, pp. A8-A9.

5. J. H. Peirce, Fire on the Hearth, Pond-Ekberg, 1952.

6. Coal Pipeline Beats Out Transmission Lines, Electrical World, December 15, 1975, pp. 58-59.

7. P. M. Boffey, NSF Grantee [Bechtel Corporation] Does Slow Burn as Coal Study Ignites Flap, Science, Vol. 190, 31 October 1975, p. 446.

MR. SHERIDAN: Before we commence, I have a correction on page 13, line 26, correct the spelling of resources, and we'll offer Exhibit 101.

HEARINGS EXAMINER: Very well, you may begin, Mr. Bellingham.

EXAMINATION OF DR. ALAN D. MORRIS

Cross, by Applicants

By Mr. Bellingham:

Q Dr. Morris, I haven't seen you since I guess it was February of 1975 in San Francisco, as we discussed previously; isn't that right?

A Yes.

Q That seems more like six years ago than one year, to me anyway, Doctor; I don't know about you.

A Sure enough.

Q May I ask you, sir, when you were first called into this case?

A Yes, approximately January of 1975.

Q And who called you in at that time?

A Mr. Lamar Tooze.

Q And who is Mr. Lamar Tooze?

A He is a partner in the law firm for which Mr. Sheridan works.

Q And that's the same law firm that Mr. Shenker also is with, is it not?

A Yes.

Q And since that time, have you been working with the attorneys for the opposition in this case?

A Yes.

Q And they have consulted you from time to time, is that right?

A Yes.

Q Now prior to the time that you mention that you were first contacted, did you have any prior contacts with the Department of Natural Resources in the state of Montana?

A No.

Q You had no impact or had nothing to do with the environmental statement that has been filed in this case by the Department of Natural Resources?

A No.

Q I assume that you are here upon an hourly or daily rate, is that right?

A At the time of our agreement made with Tooze-Kerr in January of '75, it was at a daily rate, yes.

Q And has it continued at that rate since?

A For this case, yes.

Q What is that daily rate, may I ask?

A It was established then at $300.00 per day.

Q Well, looking at your statement, you cover a lot of fields here, Dr. Morris, do you not? A lot of subjects?

A Yes.

Q We might call you a man of all seasons insofar as this statement is concerned, might we not?

A It would be very complimentary. Thank you.

Q Let's go through a few things contained in your statement; I don't have too many. On page 4 at line 5, you state, "The state will have to make great efforts to ensure that now and in the future the strip-mined land will be reclaimed and restored to its original capacity."

A Yes.

Q That appears in your statement, does it not?

A Yes.

Q Are you aware of the fact that our strip mining laws in the state of Montana have been said to be the most stringent such laws in the entire United States?

A I've read of that, yes.

Q And that would include the reclamation laws also, attached to strip mining?

A Yes. I drew that from the various readings I've done, for example the National Academy of Science study on restoration potential of the western lands and the fact that the rainfall here is very low, plants are quite fragile, and that extreme efforts must be made to restore the land; it's not easy to do. There is also a complete article on Colstrip and the restoration potential in the December issue of Scientific American.

Q Did it go into detail what is contemplated?

A Yes, it did.

Q Are you satisfied with what the state is doing?

A Well, it seemed liked they were doing -- the state or the cooperators?

Q Well, the cooperators?

A They are claiming to make good efforts. People are on one hand not satisfied and on the other hand happy. We read about Colstrip in the national press, as you well know; it has been featured in the Washington Post many times. And you read the views of the ranchers and other people who think that the processes for restoration are not satisfactory, and you read other people who say they're doing a good job.

Q Well, you'd expect to find that type of consensus on both sides, would you not, on a matter of this kind?

A Yes, indeed. There's a dispute here apparently, too.

Q Now, you mentioned the Washington Post; you are from Washington, D. C., are you not?

A Yes.

Q Well, turning your attention once again to page 4, you say, "Since the state has no need for the power that would be generated by the proposed 1400 megawatt facilities they should be located at a load demand center and not at a mine-mouth source center at Colstrip."

A Yes.

Q That's a flat statement, is it not?

A I took that reference from the red volume of the state where they said that of the Colstrip 1 and 2 in existence now, that only 350 megawatts would be utilized within Montana and the output from number 2, say, the 350 megawatts would be exported.

Q All right. Well, Dr. Morris, you have not attended these hearings, have you, previously?

A No.

Q And you have not read the transcript of the testimony, have you, for the case?

A No, sir.

Q And you have certainly not examined the exhibits, and I might say there are many hundreds of them that have been involved in this case?

A No.

Q And I think it's fair to say, isn't it, that your statement as you've indicated was taken from the state's Environmental Impact Statement, is that right?

A Yes, the red volume.

Q Right, and that's the Environmental Impact Statement that was put out by the Department of Natural Resources?

A Yes, the one that recommended denial of the application.

Q So your knowledge as far as whether or not the state has no need for the power that would be generated by the Colstrip 3 and 4 units is strictly limited, isn't it?

A Only to the statement in the red volume which said that of 1 and 2 half would be exported.

Q You're not familiar with the load forecasts of the various companies in this proceeding?

A Only as I've heard in the past several days.

Q And as far as Montana Power is concerned, you're not familiar with its load forecast are you?

A No, sir.

Q Turning to page 12, you make the statement at line 6, "If it is more energy efficient to transport energy by shipping coal from Colstrip than by sending electrical energy over transmission lines, then the 1400 megawatt facilities should not be placed at Colstrip but should instead be constructed at a load-demand center." That statement appears?

A That's essentially the significant statement in this testimony.

Q And is that statement your statement or is that statement taken from an impact statement?

A No, that is my work.

Q Now then, so that the board will know, what do you mean by energy efficient?

A When you transport anything it takes a certain amount of energy to do so, you ride a bicycle, walk along a path, and you want to transport energy, it takes energy to transport energy. In other words when you haul coal in a unit train you have to put diesel fuel in the locomotive, and therefore if you compute the energy into diesel fuel and find the energy in the coal that you're hauling, the fraction that you can form between those two is the energy intensiveness of the haul. Likewise, if you put so much electrical energy on a power line, say starting at Colstrip, and get it out the other end at someplace called Hot Springs, then you will not get as much energy out at the terminus as you will put in at the beginning; you've lost energy along the line.

Q Are you through, sir?

A Yes. And I explained that, I believe, in previous pages, I hope as clearly as possible.

Q Now then, you have not taken into consideration, insofar as that particular portion of your statement is concerned, any analysis of the costs of the two alternatives, have you?

A I've thought about that and read considerably on it, and I come here from Washington to attempt to bring to you people here the idea that costs are not now the important consideration as they long have been, and that efficient utilization of our energy resources is the prime consideration. That's what this paper is based upon and that's what I'm here to say.

Q In other words, you are asking us to throw out entirely, in any analysis of alternatives of providing for the customers of the five applicants in this case, the costs involved in providing them these services?

A No, not exactly. I said I looked at the costs before; there have been numerous studies on the comparative cost economics of shipping energy by electric wire, by unit train, by slurry pipeline, for example. Bechtel Corporation, the scientific and engineering guide behind this plant construction, participated in a southwest energy study in the early '70's; there's a working group appendix published by them available at the Department of Interior which shows at that time, in the early '70's, that the costs of shipping energy by transmission lines, by unit train and by slurry pipeline, in their opinion if you're making the study, were approximately all the same. There have been recent papers out on that very same issue, including considerations of rail, rail barge, and all barge systems, and I made reference to that paper in this presentation. This is particularly just simply a cost economics study and it showed that the slurry pipeline was the best of all, that the rail and the transmission lines were about equal on levelized and annualized bases. So when I come and tell you about considering energy basis as a prime factor, I'm not throwing away entirely relative costs. I've seen all sorts of costs and cost charts, but the best information I have from sources considered to be very reliable is that the costs are approximately the same.

Q Well, are you aware of the alternative studies that have been made and put into evidence in this case?

A I have heard that people have made presentations on relative costs, yes.

Q But you have not examined those?

A No, sir.

Q Now you have not, yourself, investigated the alternatives in this case, have you?

A As far as costs are concerned?

Q Yes.

A No, I look at energy, sir.

Q Yes, but have you investigated the energy in this case?

A The energy, yes.

Q You have?

A The relative energy intensiveness, yes, of the transport.

Q Do you have a study on that that you've prepared?

A Yes, it's right here.

Q It's in your statement itself?

A Yes.

Q Well do you have any figures in here that you used and this sort of thing?

A Yes.

Q Where is that?

A Essentially it starts on pages 12 and 13. If you would like I'll detail how I came about these conclusions.

Q Well, let me ask you this, though. You have taken general studies, have you not?

A Yes, sir, I took information from the well known studies of the United States of America today.

Q All right, fine. You've taken these studies and attempted to apply them to the situation at hand?

A Well, they had data and information in them that was particularly applicable to this case. These studies are a center of controversy right now in Washington, as you might well know. The one case, the large study, was prepared by Bechtel for the past several years, and the other study done by the University of Illinois was a long-standing study on energy transport, strictly of coal; it's called the Coal Future. I have seen previous studies, figures of which are not dissimilar from these very recent ones that I used; I have used the latest up-to-date studies done in the United States.

Q Now, everything that you've done insofar as comparing the alternatives in this case is contained in your testimony; is that right?

A No, I have done much more than is contained here, but this is a good summary and an up-to-date view.

Q You haven't prepared an exhibit to be introduced, though?

A A computation?

Q Yes.

A No. I started with, for example, the rail haul energy back in January of 1975, by first contacting Eric Hearst who was at Oak Ridge Laboratories and then moved to the Federal Energy Administration in Washington. He was the author of the well known first paper on energy intensiveness of transport. It is well referenced. He now works for the state of California in Sacramento. He had figures on the Btu per ton mile for shipping goods by rail, and I called him to find out if he could separate out numbers for unit train hauling of coal. He told me that his data were collected at a time where they were on the average and that they should be far better refined for specialized unit train hauling of coal than his numbers which were gained by averaging all sorts of freight shipment and even passenger trains. So he advised me of the places where I could go to get more refined information, including the FEA, Federal Power Commission, Burlington Northern Railroad. I did use his numbers as a base and it worked out using his figures, which he admitted were high, that the unit train energy intensiveness was about 5 percent. I called the people who had prepared the computer model for the Project Independence study done in 1974. Their model is based on approximately Hearst's data. Then in trying to get further information on railroads by calling Burlington Northern, I found that they had given actual fuel usage figures and ton-miles of coal hauled to Professor Rieber for purposes in his study, and they referred me to him. So we obtained copies of Rieber's studies, and the figures that I present here are taken from his tables; I've worked the calculations over myself just to see how they go in comparison with the old figures that I got from Hearst, and as Hearst indicated to me, the numbers are better because we're dealing here now with specialized trains dedicated only to hauling coal, and optimized for that, instead of averaging over-all freight. Does that give you an idea of how I went about this?

Q Yes, it does. Have you referred to any specific studies that have compared these alternatives insofar as Colstrip is concerned and the ultimate destination in the Pacific Northwest?

A Yes, I remember a study I saw a long time ago done by a gentleman named Forrest Blood who works, I think, for Bonneville, who had done just this sort of work on figuring the energy intensiveness of coal transport by unit train versus the anticipated energy loss on the power lines. I haven't seen that document for a long time, but I remember reading it.

Q Well, this particular document was dated what?

A I believe it was done in '74. It was basically a cost document.

Q And what alternatives did it consider?

A It was this unit train hauling of coal versus electric transmission lines.

Q Now what were the destination points in that study?

A They seemed to be western destination points.

Q Well, are there any specific ones that you remember?

A No, I can't remember the towns and the points. I was interested in his study because he was considering shipment west.

Q Well, do you know whether or not Colstrip was one of the towns?

A I seem to remember that Decker was mentioned.

A And you're not sure about Colstrip?

A I haven't seen that document now for over a year.

A Do you remember the figures involved?

A Yes, his figures were similar to Hearst's, and as a matter of fact, now it comes back to me, he did use Hearst's data. His data for energy shipment of coal were based on Hearst's data and that's why he referenced Hearst, I believe, and that's why I got in touch with Hearst.

Q Well, you're not sure, though, that these studies considered the alternative of mine-mouth generation at Colstrip as compared to transmission of electricity from Colstrip to a destination in the Pacific Northwest?

A Yes, it was dedicated just -- Forrest Blood's study was dedicated just primarily to that.

Q From Colstrip?

A From eastern Montana to the west.

Q You're not sure it was Colstrip?

A No, I can't say that; I seem to remember Decker.

Q Now, let me ask you, do you know how far it is from Colstrip to Spokane?

A No, I think it's 400 or 500 miles to Hot Springs.

Q If I told you that that's considerably less than the actual mileage, you wouldn't be surprised?

A The air mileage -- I don't know.

Q Well, what about railroad mileage; do you know?

A No.

Q What about the distance from Colstrip to Boardman, Oregon, for example; do you know what that might be?

A No.

Q Do you know what the mileage, and I'm talking about railroad mileage, from Colstrip to Seattle area is?

A No.

Q Do you know the mileage from Colstrip to Spokane? Perhaps I've asked you that?

A Yes, you said it would be longer than I thought. My information developed here does not depend specifically on distance.

Q We understand that. Now, do you know how many mills per ton mile it would cost to ship by unit train coal from Colstrip to

Spokane?

A I've heard figures; I've read them; I don't remember them.

Q Well, do you have any range of figures that you remember?

A No, I haven't got them with me; I've seen them many times.

Q Could that be six mills per ton mile, eight mills per ton mile, ten mills per ton mile?

A I've seen endless figures on mills per ton mile, and cents per kilowatt hours and all sorts of things; they don't stick in my mind.

Q Well, do you know how many mills per ton mile it might cost to ship by unit train coal from Colstrip, for example, to Boardman, Oregon?

A No.

Q The same question with the destination being Seattle?

A No, I have no figures for ton mile shipment costs in my mind.

Q Do you know what the average escalation of railroad rates for the shipment by unit train have been over the last five years?

A Yes, I've read that the railroad, being labor intensive, is very inflation prone, as opposed to other means of shipping energy, and I do not view that now as being a bad factor. The President has said that he doesn't want to give out money from the federal government to provide thousands of jobs; he wants to give incentives to industry so that industry will provide jobs, and therefore I say if you can find a more energy intensive efficient way to ship energy, that also at the same time provides lots of jobs, then you ought to go that route.

Q Well, now let's go back to my original question; do you know what the rate of escalation has been, say within the last year?

A I remember reading in the Bechtel study for the ETSI pipeline the comparison between the slurry pipeline, which is supposed to be very capital intensive and the railroad, that they showed a fraction of the railroad of 50 or 60 percent that was labor sensitive and therefore sensitive to increase in labor costs. I'm no economist so I can't give you those numbers.

Q Well, this is fine, but to get back to my original question, I take it that you're just not familiar with the escalation of railroad rates within the last year or two?

A I take it in my mind in doing this work to essentially reject cost figures. I don't believe in them and I'll tell you why. I have some background in it. As a conventionally trained electrical engineer, my first sort of work in designing small power lines, small substations, was to compare costs of various installations. In order to do that for, say, a customer who wanted to decide whether he wanted to take power at high voltage at a preferential schedule and install his own transformers and switch gear as opposed to taking voltage at utilization levels and letting the power company put in the transformers and switch gear, was something you would work out to advise him whether he should take power at primary or power at secondary voltages. This was done based on the power company's schedules and demand schedules. Now, recently, about a year ago, we were asked by an old customer to do this sort of job again, whereby three racetracks in Maryland would share a diesel generator that would be moved around on a flatbed from one track to the other in order that they generate their own power, using diesel fuel, and not buy power from the power company and pay the huge demand rates. They have to pay those rates because they only use power for a few days per year, but they must pay the rate all year long. I turned the job down. Now, most of the books that I have on standard cost economics or engineering that I got when I was in school, if they didn't have high clay content I could use them for kindling in my Franklin stove. I don't think they're worthwhile anymore because rate schedules are changing all of the time, the power companies in our area are going to have to move, the gas company also, to charging the same per unit energy consumed no matter how much you use; there will be no more bulk rate discounts for large buyers. Now, with that in mind, I'm not really ready to make any cost projections for anyone, and I don't even want to get into it, and I don't believe anything that anybody will give me or present to me has no meaning to me whatsoever. I realize that you've got to do it because that's the way it's been done, but I don't believe in it.

Q You will fiercely resist the giving to you of any information that might help you in this regard?

A Absolutely. Not that my mind's made up; it's just that I can't assess it; I can't use it; I'm not ready for it; I am not interested in costs per this and mills per ton mile. I'm here to try to protect and show you people the best way to use your resources to make Montana, which is in the nation's eye, really it is, a model for all the rest of the country. I can't do that with mills per ton mile; I can do it with Btu's conserved.

Energy is costing us all more, as you well know. There are people in the Maryland area who are paying more for electricity per month than their mortgage and have been forced out of their homes; they are very sensitive to these problems. So it has become very apparent to me that energy is more important than these cost figures; that's how I feel about it.

Q Well, to go back to these various alternatives, your study then I could term perhaps rather esoterically based upon general figures and studies that have been prepared by others?

A I specifically listed these two reports, although I have consulted many, many other reports whose results are not dissimilar to bring you the very latest and supposedly best information available in the United States, including a massive half million dollar study produced by Bechtel Corporation in San Francisco for the energy research and development.

Q Well, we could have a situation, could we not -- now I'm comparing alternatives -- you know what I mean by that -- where one alternative is more energy efficient than the other, but much more costly. We could have that situation couldn't we?

A Yes, indeed.

Q And if you have this situation where one alternative was more energy efficient but much more costly, it would be your approach that in view of the national energy picture today, that our choice should be that we should pick the more energy efficient alternative?

A Yes.

Q And you say that without any equivocation?

A Yes.

Q All right. Now, you were here this morning when I discussed with another witness the obligations that a utility, now I'm talking about a privately owned utility, has to its customers, were you not?

A Yes.

Q And I think the statement was made there that the obligation of a utility to its customers is to provide services at the lowest possible cost; isn't that right?

A I heard you say that, yes.

Q And I think the witness at that time indicated, and we're talking about Dr. Brewer, of course, that that is the obligation?

A I have heard that said. Of course, I'm subject to the monthly rate increases of Potomac Electric Power Company, and I can't agree that that's what they are doing.

Q Well, do you know anything about the power increases out here in the state of Montana or in the Pacific Northwest?

A I hope they're not the same as what we have, sir.

Q Well, you're not familiar with them, are you?

A No. I assume the pattern of the utilities here is similar to those in the east where they are on a constant treadmill, building new plants, selling preferred and regular stock, they have been selling bonds to maintain the proper dead equity ratio for the financial community's picture, they have been coming back for ever increasing rate increases to pay for all that, and since PEPCo, for example, serves part of Maryland, the District of Columbia and northern Virginia, reciprocal rate increase applications come all the time. They are there and they don't see any way different; they keep doing the same thing over and over and over again. People are getting very, very upset. The local community is appearing at meetings and making even stronger protests and suggesting ways for the power company to improve their load factor and ameliorate their peaks and not have to go on this constant construction program. That's what's going on there.

Q Well, you are aware, of course, in Montana, are you not, that the rates of the utilities are controlled by the Public Service Commission?

A Yes.

Q And this is true in most states, isn't it?

A Yes.

Q And they do not obtain these rate increases willy-nilly, do they?

A In our state now the process has been opened up to a great deal more investigation, and certain costs that were commonly put into the rate base have now been denied, and many changes will certainly take place this year. The whole process is no longer viable.

Q Now, that's the process you're talking about in your state?

A In Virginia and Maryland and --

Q You're not familiar with the process that's been utilized out here in Montana, are you?

A No.

Q Nor in the Pacific Northwest?

A No. Of course you're fortunate out here to have a lot of power from hydro power which God gives you from the sun.

Q And your conclusion on page 13, lines 18 through 22, is based upon energy efficiency only; isn't that right?

A Yes, it comes from the lines above where there is an astounding ratio, from the sources that I've quoted, between the energy intensiveness of coal transport by specialized unit train on the order of 1 percent or less, compared to transmission lines which are about on the order of 10 percent, a factor of 10 to 1. Now try it against 1400 megawatts for the proposed 3 and 4.

Q You indicate at the top of that page 13 a quotation that, "Transmission line losses can be substantial, amounting to as much as 10 percent of the line loading per 100 circuit miles of transmission."

A Yes, I took that from the Bechtel report, quoted from the report shown on the previous page.

Q Do you know what the transmission line losses are projected insofar as transmission of energy from units 3 and 4?

A I've heard various figures.

Q And what are those figures?

A They seem to range from 5 to 15 percent is what I've heard.

Q Well, would you be surprised if I told you that our figures on line losses are approximately 4.25 percent from Colstrip to Hot Springs?

A Those are projections based upon your engineering department work?

Q Yes.

A Yes, it seems low. You will know when the line, if it is, is built and you put a meter at the beginning and one at the end and you'll find out. There seems to be a lot of problem in getting data on a line that's not yet built, as to what its losses will be. I know on an overall average that the data used by the Federal Energy Administration in preparing the computer program for Project Independence were -- electrical transmission was an important factor -- that the number used was 10 percent on average. Some plants are located right where the load is, so there's no loss. I did make an effort to calculate this myself as a matter of fact, and consulted various references, studied bird wing, lap wing, eagle, mallard, double eagle mallard, blank vat configurations, tower configurations, soil conditions and all of the factors that go into such a calculation and decided that this is an extreme area of specialization and that I best seek information from people who had done this work before and used the figures before. Even if your figure of 4.2 percent as anticipated, only calculated, is right, then it's a factor of about four times that from the unit train hauling. Now, in normal operational analysis in many, many systems a hemibel improvement, which is a factor of three, is considered significant. A factor of ten decibels is considered great. So if you have, as you indicated, a factor of four, that's a significant improvement.

Q Well, you don't reject this figure I gave you, do you?

A I can't do anything with it; I don't know.

Q You haven't made a detailed study yourself?

A No, who has? The Montana Power Company has done so?

Q Well, the engineers certainly have, yes, and the engineers at C. T. Main.

A Yes, well the people, or the Department of Natural Resources also consulted with a power line transmission design company, Commonwealth Associates, I believe it's called, who gave them the best available figures of 5 to 15 percent.

Q Now, let's turn to page 14, line 19. You say, "If options are left open and the proposed 1400 megawatt conventional power plant facilities are not sited at Colstrip, new and more energy efficient processes can be employed for a power plant to be sited at Colstrip, or elsewhere." What do you mean by that?

A Well, I understand that plants such as this have a useful lifetime of 30 to 40 years, the plant you propose to build. Hopefully, and very importantly, within the next decade at least we should have available technology in the United States to site different kinds of plants that are far more efficient than these conventional fossil-fuel plants that you propose to build, and if your plants are not located at the mine-mouth site at Colstrip, it leaves the potential for placing there something, and you've discussed all these other types of technologies, that will make use of the coal in a conversion method that is far more efficient than the projected 30 percent conversion efficiency of this plant. Those numbers, by the way, I take from the applicants' own letter to -- on their scrubbers -- to the EEI, and their projected efficiency of this plant was 33 percent. From the Bechtel report that I referenced before, their efficiency given in the report, the scrubber penalty was roughly 30 percent. I would hope that United States technology could certainly try to utilize energy from our coal resources at hopefully 40, 50, or 60 percent, getting as close as possible to theoretical Cornell efficiency, and that is abysmal in this day and age to put down a plant that takes coal, which is not renewable, and burn it at 30 percent efficiency and reject and throw away 70 percent of the energy in the coal.

Q Then in effect what you are asking us to do here, and in effect you are recommending to the Board of Natural Resources, that nothing be done regarding generating plants, as far as Montana Power and these applicants are concerned, until possibly 1985 in the hopes that new technologies at that time will be developed in order to make more efficient plants; is that right?

A No, I don't say that. In the beginning of this report I made it quite clear that I know and well recognize that more coal must be utilized. I personally feel that if you're willing to put in a modern plant and you need the electricity that it will generate, there seems to be some dispute about that, that you will have to go ahead and do it, but do it someplace near a demand center and not at a source center, such as the mine-mouth at Colstrip. That's all that I'm saying. Leave Colstrip open for future, more efficient development. As a matter of fact, you can leave it open for a slurry pipeline to ship the coal in a very efficient way without impacting the community at all.

Q Fine, we'll get into slurry pipelines in just a second, I can assure you, Dr. Morris. Well, the construction of 3 and 4 units certainly does not preclude the later construction of more efficient plants, does it?

A I only made the point that if 3 and 4 are sat there, that they will be there for a long time, well past the time where, God willing, we will have more efficient processes. In the meantime, while Colstrip 3 and 4 are sitting at Colstrip, they are using more energy from the coal than they should because they are sending their power to the demand center in a relatively inefficient, capital intensive, non-job providing way.

Q All right, fine. Let's assume, then, that these plants are not going to be located at Colstrip, but instead the coal is going to be shipped, say, to some northwestern area, say Boardman, Oregon or Spokane, perhaps, and generating plants will be erected at those sites. Are you with me so far?

A This is an assumptive scenario you're putting forth?

Q Yes. Well, those generating plants that are going to be located in those places are not going to be any more efficient, are they, if they are built within the time schedule that 3 and 4 are to be built --

A True.

Q Any more efficient than 3 and 4 are they?

A Exactly. Well, they'll be designed a little later; they might be more efficient, I don't know.

Q But certainly they won't be as efficient, say, as if we wait 10 or 15 years?

A No, but the overall system of coal and power plant and energy is more efficient if you locate the plant at Spokane and bring the coal to it by rail than if you locate the plant at Colstrip and bring the energy by electric line to Spokane. So if you consider the system of coal, power plant and energy, that system is more efficient if you locate the plant at a load center.

Q You heard Dr. Brewer talk this morning about so-called exotic or other alternatives coming up in the future?

A Yes.

Q And I think you certainly agree with his analysis that it's well down the road, isn't that true?

A I hope not. I really hope not.

Q Well, do you agree or disagree with his analysis?

A I think you were talking about fusion --

Q Well, yes, he presented several. Do you recall?

A Yes, he talked about MHD, fusion, windmills I believe you went over.

Q Solar?

A Yes.

Q Magneto hydrodynamics --

A MHD, yes, you have a development institute here in Butte.

Q Yes. And these things are well down the road, are they not? Past 1985 for example?

A At 8:30 on Monday night, this Monday night, I watched channel 11 in the motel room, KUED, Salt Lake City, a presentation from Utah State University in Logan, Utah, address radio and T.V. 85; you can write and get this program. There they have a six year program to utilize solar energy -- it was a fascinating program -- by scattering what you might call readily available coal fly ash from an airplane at the rate of 200 pounds per acre in the months of January and February on snow; the snow melts at a controlled rate because the blackened snow absorbs solar energy; the winter wheat grows without snow mold, produces instead of 5 bushels an acre, 25 bushels an acre; the water runoff is controlled and slow; it is absorbed into the ground rather than running off, and this is a direct use of solar energy a few miles south apparently of this place. I don't think it's that far away if people put their thinking caps on and go to work.

Q Well, Dr. Morris, that's very interesting, but it doesn't unfortunately, help Montana Power's generating problems if they're going to have a deficiency in '79 and '80, does it?

A If Montana Power Company has demonstrated a need for electric power as they claim to have done, and as the other side has shown they don't, but let's assume that they do, then all I'm telling you is that they take their standard plant 3 and 4 and put it near a demand center. Mine-mouth generation of coal is an inefficient method and I can say that from my own calculations, and it's a main precept of Bechtel's report.

Q Now, being a reasonable man, which I assume you are, Dr. Morris, you will agree with me, will you not, that there are other experts in the field who will disagree with you on that point?

A Yes, they seem to disagree, as you began, on a cost economic basis. I haven't heard anyone yet discuss energy utilization. Now, that's why I'm here to talk to you. If someone differed with me on an energy basis -- because we're talking about conservation of our nonrenewable resources, namely coal.

Q Let's move over to a -- were you asking me a question? You realize I'm not under oath?

A I haven't been to all of these hearings and I have not seen anything other than what I said with regard to mine-mouth generation energy inefficiency in the Bechtel study just released, but you said that other people disagreed with me and I asked you if it was based on cost economics.

Q What I'm talking about is disagreeing with you as to whether or not mine-mouth generation is a better alternative than shipping coal?

A From what point of view?

Q Well, in the final analysis, on a cost basis, yes.

A Well, we discussed before, I'm not talking about a cost basis.

Q You're not interested in a cost basis, are you?

A I have heard that the costs are similar, and even if they were greater to ship by rail, I would still say go that way if the energy utilization was better; sensibly better is the word I would even use.

Q I take that slurry pipeline is a pet of yours?

A No.

Q It isn't?

A No, I'm reporting to you on information that I have read recently from various sources, and the slurry pipeline, of course, is very topical, very controversial and very interesting because it is claimed that it is an extremely efficient method to ship coal; at the same time, of course, it takes water away from where the coal is located, normally a scarce water region, and dumps the slurry coal in a place like Arkansas where there's lots of water. That's the basic objection that people have to it, the fact that it takes water from a scarce water region. But when I read in the carefully prepared studies by Bechtel that for the same amount of coal, say at Colstrip, that the water utilization using the slurry pipeline is one eighth the water utilization for the same amount of coal from a mine-mouth thermal plant, then it seems to be a pretty good idea.

Q Now have you done any specific work, insofar as slurry pipelines are concerned, other than analyzing and reviewing reports, studies, publications prepared by others?

A Well, studies on slurry pipelines have gone back for many years, and the studies that I've reviewed have been Bechtel's, that I mentioned, and Rieber's. There was a big controversy between Rieber and Bechtel on this issue from Wyoming to Arkansas. So much information was developed in recent senate hearings and many figures were given. These hearings were held in December.

Q Well, to go back to my original question, have you, yourself, made any analysis or studies on slurry pipelines?

A Not on slurry pipelines, no.

Q Now, you mentioned that there was a conflict in the Rieber studies and the Bechtel studies?

A Yes.

Q What conflict are you referring to?

A Well, the conflict was a conflict of Bechtel which Rieber -- I don't think there's a conflict in the studies themselves. The Rieber study was done at the University of Illinois for Banner-Champagne over the past number of years on the coal future, the best use of coal, and was done for the National Science Foundation under the RANN program. Rieber concluded that to put a slurry pipeline from the Madison Reservoir in Wyoming to Arkansas would be a disastrous mistake as long as there's a railroad of any kind of capacity running parallel or nearly parallel to that line. Bechtel was meanwhile engaged in a half-million dollar study for ERDA on the same exact problem, and when they heard that Rieber had said this they engaged a prestigious Washington law firm to try to get his study stopped, and as a matter of fact they made NSF make Rieber recall his reports and put a disclaimer in all of them that his work was funded by the federal government, but at the same time the federal government did not necessarily agree with what he said. In the meantime, Bechtel had done the very same study on the pipeline for the federal government, ERDA, and is actively engaged in trying to get the right of eminent domain to cross the railroad tracks and to put in an 1100 mile slurry pipeline from Wyoming to Arkansas. And so the hearings were held on the conflict between the company who on one hand is studying the efficacy of various means of energy transport and on the other hand concluded that the way they were going to build a pipeline was the very best way to go. It's very interesting.

Q Well, as far as this Wyoming-Arkansas pipeline is concerned, it's presently not under way, is it?

A The studies have been under way I think since '70 or so.

Q The construction is not under way?

A They have no right to put it in; they can't cross some 29 railroad tracks.

Q Isn't that right. And the railroad companies, in fact, have refused to allow them to cross their railroad tracks; isn't that right?

A Well, the senate, of course, passed that bill last year; it's now before the house, and I don't know how it will come out.

I don't altogether agree with the railroads either. I don't think the railroads will be able to carry all the coal that will have to be carried.

Q Well, as a practical matter, it's being held up right now because the railroad companies refuse to grant them access across their railroad tracks; isn't that right?

A Yes, they need the right of eminent domain. The railroads argue, of course, that they are a multipurpose carrier capable of providing interstate commerce, whereas a slurry pipeline is a one way, one commodity carrier.

Q You mentioned the Bechtel Company once again, as you have several times here?

A Yes, sir, I've used their materials extensively.

Q And I gather that in your opinion Bechtel is very reputable and an excellent company in its field?

A I think Bechtel has a tremendous engineering, scientific and construction capability. I'm surrounded by Bechtel in Washington. They are building the subway, Calvert Cliffs and endless things. I have been to their place in San Francisco and met several people there and I was very impressed with them. I don't agree with all that they say or do now.

Q Do you know how many slurry pipelines are presently in existence and actively being used in the United States?

A Yes, sir.

Q How many?

A One.

Q Yes, sir, and where is that?

A That's in the Four Corners area, shipping coal for about 273 miles. The one in Ohio was abandoned some years ago.

Q All right, let's go into the one that you mentioned in the Four Corners area. That's called the Mohave installation, is it not?

A Yes.

Q Now, I have 279 miles; you say 273?

A Well, I was just going by memory.

Q We're not going to quibble about six miles; we're talking about the same thing?

A I don't even know it's throughput; do you know it's throughput?

Q No, I don't. What states are involved?

A I guess it's in Nevada as far as I know.

Q Arizona and Nevada, is it not? Do you know who the major participants are in that slurry pipeline?

A No, is it Peabody Coal; I don't know.

Q Well, I'm talking about utility companies, Southern California Edison; does that strike you?

A Yes. It's supposed to be a very successful line and a good example, according to what I've read.

Q And in that case, there is no railroad that runs from the coal fields where the coal is being shipped to the site location, is there?

A As I recall, one of the basic reasons for that line was -- and for the failure of the one in Ohio which did have a railroad line parallel to it -- the one in Ohio is shipping garbage now -- the one in Nevada, I understood that at least 100 miles of rail line would have had to have been constructed, so therefore, the economic analysis showed, and Rieber would agree, that the slurry pipeline was more cost effective.

Q Now, let's go to the Ohio one --

A Yes, that was the first one in the United States as I recall.

Q What company was involved in that?

A I don't know. American Electric Power?

Q What about Cleveland Electrical Illuminating Power; does that strike a note?

A Yes, it's a short line, as I recall.

Q Do you recall the mileage?

A 80?

Q Well, would approximately 108 or so --

A I don't remember exactly, no.

Q You wouldn't reject that figure, though, would you?

A No. I think it was in operation for some years until the railroad dropped their price and made railroad shipment more interesting and the line was abandoned.

Q And that's exactly what happened, isn't it? It was abandoned after two years because the railroads dropped their prices and that took care of the competition; isn't that right?

A Yes. Very good.

Q So I think we can agree then that there is only one slurry pipeline operating in the United States at present?

A I think there are other slurry pipelines carrying other things, not coal.

Q Well, I'm talking about coal?

A Coal, as far as I know, the one down near Four Corners.

Q Well, I gather that you would like to see, if possible, a slurry pipeline from Colstrip to whatever center might be involved, wouldn't you?

A East, you probably mean.

Q Well, let's go east?

A I guess so. It would be hard grade going west.

Q Well, do you know that a lot of Colstrip coal is being shipped to the midwest; are you aware of that?

A Yes, I am.

Q And I assume that you know that these shipments are by train, of course?

A Yes.

Q And it is your feeling that it would be more beneficial to ship this coal by slurry pipeline?

A If you had to ship a great deal more coal beyond the capacity of the railroads, beyond their availability to get hopper cars and improved trackage and more engines, and the alternative now is not between your locating the plants at Colstrip or at Spokane, but merely building the plants at all anywhere and using the coal, or not building the plants and letting the coal be shipped to somebody else so that the water is only used for the shipment of the coal in the slurry, then it would be, apparently, from the figures that have been released, an energy efficient way to ship the coal with minimum water utilization.

Q And you're talking now to the midwest area?

A Yes, to Chicago or to Minneapolis, I suppose, or south.

Q Well, the same would hold true insofar as shipment to the south is concerned, also?

A There is another line proposed that does go to Texas from your area.

Q All right, what about shipping coal by slurry pipeline from Colstrip to the Pacific Northwest?

A Well, the proposed line that goes south crosses very rough terrain and requires a lot more in the way of pumping stations. I have seen no proposals about going from Colstrip across the Rockies to the west. I imagine that could be done, but it might take a lot of horsepower.

Q Because of the mountain ranges?

A Yes. The one that is proposed from Wyoming to Arkansas is pretty much a downhill route all the way.

Q Sure. Now you haven't made any studies insofar as Montana shipment of coal by slurry pipeline to any location?

A I haven't seen any done by anyone. All the proposed routes go the other way.

Q And you know of no restrictions upon the shipment of coal by slurry pipeline from Montana to areas outside the state, do you?

A East or south?

Q East, south, north or west?

A I don't know what would happen if you went west because of the terrain. I have seen proposals for south, yes.

Q But you know of no other reasons other than cost factors as far as terrain is concerned, and so --

A Well, again you would find that if you wanted to site a station to grind up coal and mix it with water at Colstrip, the state might object to your taking the water out of the state. It's possible; people are objecting to that in Wyoming; I don't know.

Q Well, are you aware, Dr. Morris, that under our statutes of the great state of Montana it is absolutely illegal to use water for slurry pipelines to export coal from the state of Montana? Are you aware of that?

A I had heard of that, yes; I think I've heard that, yes.

Q Where did you hear that?

A I may have read it in one of the senate hearings; I don't know; it seems familiar to me.

Q When did you first hear it?

A Oh, recently while reading -- I'm not certain; it may not be true or it may be true; I can't recall. I seem to have read something like that. Of course, it may have been in connection with the Madison Reservoir; I don't know; I'm not sure.

Q You didn't make any mention of any statute or any law or anything here in your paper, did you?

A No. Water things have changed through the years. I know that the Bureau of Recreation has leased water at very low cost per acre feet to the coal companies over the years, so a lot of it is spoken for, I suppose. Things can change; laws can be changed.

Q Do you know when the law was passed that made it illegal to ship coal by slurry pipeline from the state of Montana?

A I know nothing about your law, no. That is true.

Q You really weren't aware of the fact that that law was on the books, were you?

A No, not that I can recall.

MR. BELLINGHAM: No further questions.

Redirect, by Department of Natural Resources and Conservation

By Mr. Sheridan:

Q Dr. Morris, Mr. Bellingham has been asking you quite a few direct questions about cost analysis. In your study and the statements that you have contained in your testimony addressed to cost analysis, or is it addressed to the most efficient utilization of energy nonrenewable resources?

A It's devoted primarily to best utilization of energy.

Q And are we concerned, then, with an analysis focused in this nature upon mills per ton mile or Btu's?

A We are concerned with Btu per ton mile.

Q What's the method of analysis you use under this particular methodology?

A What you do is make a comparison between the energy needed to transport a block of energy with various transport modes, and once you've done that you compare them and see which one is more efficient.

Q Based upon Btu's?

A Well, any common unit of energy.

Q And that being the common unit?

A Yes, very much accepted, yes.

Q Mr. Bellingham also asked you questions regarding energy efficiency. Have you made any analysis considering the effects of energy conservation upon the efficient use of energy?

A Well, those factors were very well addressed, I thought, before by Dr. Brewer, but in summing up what he said in a way in my own light, my own view, if we could make up our minds to achieve a 10 percent decrease in energy usage through thoughtful conservation practices, and I'll append to that the idea that the City of Los Angeles through merely ordinance achieved a

20 percent cut last year for a period of several months by just telling people not to use as much electricity, and if on the other hand we utilize methods for energy generation that are 10 percent more efficient and apply those two 10 percent figures against our energy needs and resource needs, we would be a long way down the road toward energy independence.

Q Did you consider anything else the utilities could do to diversify their activities in support of development of energy efficient operation?

A Yes, there's been much discussion of what routes utilities can take to still be in a profit making business, selling services, without increasing their generating capacity continually. The government has just given a grant to the city of Pasadena to encourage a thermal energy park where a power plant will be integrated with a certain area and all waste energy from the power plant will be utilized. The utilities should try to make use of their waste heat; they should try to increase the load factor of their existing plants; they should take the strongest methods possible to ameliorate their peaks, and this can be done; it's being tried in various places through peak rate metering, through changing the tariff schedules so that people get to know that when you use electricity that's on peak, that they're paying the full marginal costs and not an average cost. So there are a number of things that are being considered by various utilities around the country in the way of offering services, good services, and yet at the same time not necessarily increasing their generating capacity construction.

Q Mr. Bellingham also asked you of your impressions of Bechtel, and you stated that sometimes you didn't agree with what Bechtel was doing. Are you familiar with any problems that Bechtel has had specifically with respect to Calvert Cliffs, which you mentioned in your testimony on cross?

A Well, I think the Calvert Cliffs episode is well known nationally. Several people went to jail because the construction foremen were taking bribes in the construction of the generating facility there. Bechtel is a large company operating all over the world and I guess it's difficult to have intimate control of every project.

Q Some of the items supplied for use at the facility at Calvert Cliffs were sole source suppliers, weren't they?

A Pardon?

Q Some of the equipment supplied pursuant to bid were resulting from sole source suppliers to Calvert Cliffs?

A I've been told that, yes.

MR. SHERIDAN: I have nothing further.

MR. BELLINGHAM: Nothing further, sir.

HEARINGS EXAMINER: Very well, sir, you are excused. We will take a ten minute recess before you call the next witness.

(WITNESS EXCUSED)

(BRIEF RECESS AT 3:15 P.M.)

Following a brief recess, the hearing reconvened at 3:45 P.M. on February 18, 1976.

HEARINGS EXAMINER: Are we ready, gentlemen?

DIARMUID F. O'SCANNLAIN, called as a witness by the Department of Natural Resources and Conservation, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

(THE WRITTEN DIRECT TESTIMONY OF MR. DIARMUID F. O'SCANNLAIN WAS DIRECTED TO BE INSERTED AT THIS POINT.)

WITNESS STATEMENT

OF

DIARMUID F. O'SCANNLAIN

My name is Diarmuid F. O'Scannlain. I reside at 2421 S.W. Arden Road, Portland, Oregon 97201. I am engaged in the private practice of law at 3500 First National Bank Tower, Portland, Oregon 97201. The nature of my practice involves general corporate work with some emphasis on financing, energy-related, environmental and administrative law. I received my J.D. degree from Harvard Law School in 1963. I served as an attorney with Standard Oil Company of New Jersey (now Exxon Corporation) from 1963 to 1965. I came to Oregon in 1965, where I was in private practice until 1969. From 1969 to 1974 I was in state government, where I served as the Deputy Attorney General of the State of Oregon from 1969 to 1971, as the Public Utility Commissioner of Oregon from 1971 to 1973 and as Director of the Department of Environmental Quality of the State of Oregon from 1973 to 1974. From 1971 to 1974 I served as a member of the Nuclear and Thermal Energy Council of the State of Oregon, ex officio, first in my capacity as Public Utility Commissioner, and thereafter as Director of the Department of Environmental Quality.

My assignment in this proceeding is to address the question of the extent to which governmental agencies at the state level can perform the job of planning energy needs. I have not been asked to support or oppose the recommendations of the Montana Department of Natural Resources and Conservation, nor do I have an opinion with respect to the recommendations it has made in these proceedings. I will, however, express an opinion with respect to the capability of a government organization such as the Department to make informed recommendations with respect to the need for construction of additional power and energy conversion facilities, together with the effect of such facilities on environment, population concentration and the welfare of the citizens of Montana.

My experience, in this context, relates primarily to my service on the Nuclear and Thermal Energy Council of the State of Oregon. Under ORS 453.305 - 453.755, the Council was charged with the responsibility of certifying the construction of all thermal power plants and nuclear installations in excess of 200,000 kilowatts. The Council was staffed with a full-time Director and several full-time professionals. The Council met monthly and had broad powers to inquire into the implications of the siting of power plants throughout the state. The staff received vast amounts of technical data from many interested sectors of the Oregon economy, including power companies, the Bonneville Power Administration, members of the academic community and citizens. Based on many days of testimony and voluminous submissions, the Council inquired into and made determinations with respect to the electrical energy needs of the State of Oregon and of the Pacific Northwest.

(By virtue of Senate Bill 483, passed by the 1975 Legislature, Chapter 606, Oregon Laws 1975, the functions of the Nuclear Thermal Energy Council have been converted to the "Energy Facility Siting Council," a division of the newly created Department of Energy. Based on my review of Senate Bill 483, the changes made by the 1975 Legislature do not affect the conclusions I have reached).

In my capacity as Public Utility Commissioner of Oregon, I was responsible for the regulation of public utilities, including investor-owned electric utilities. In this connection, I reviewed numerous documents with respect to projections of loads, forecasts of resources and loads, historical data with respect to prior projections. Such information was commonly taken into account in connection with rate determinations made in applications for rate increases.

In my capacity as Director of the Department of Environmental Quality, I was conversant with environmental aspects of electric power generation. I personally visited the site of the coal-fired 1,400 megawatt generating facility operated by Pacific Power and Light Company at Centralia, Washington and I have inspected the construction of the 1,130 megawatt Trojan nuclear plant operated by Portland General Electric Company near Ranier, Oregon. Some of the environmental aspects of electric power generation include the possible impact on air quality from emissions of certain classes of pollutants, possible impacts upon water quality from certain types of effluent, certain solid waste disposal problems from certain classes of power plants, as well as possible noise pollution problems.

Based on my experience in state government in the three capacities previously described, I have reached the conclusion that a state agency with a sufficiently clear mandate can perform the functions of planning for energy needs in conjunction with private utilities whose function it is to meet such needs. The role of the state agency is to balance all of the relevant considerations, such as load forecasts, environmental effects, economic and rate impacts.

With respect to planning on a regional basis, both the Oregon Nuclear and Thermal Energy Council and the Public Utility Commissioner of Oregon have demonstrated their ability to take into consideration both the state energy needs as well as regional energy needs because of the peculiar circumstances in which any loads within the service area of the Bonneville Power Administration may lie. Both the staff and the policy-making level have demonstrated a capacity to look at the implications of such need projections, to challenge them intelligently and to reach conclusions with respect to their viability in making routine determinations with respect to siting of power facilities as well as approval of power rates.

Of course, the state itself must decide what the extent of its own "region" shall be. In the case of Oregon, while it lies within the Bonneville Power Administration service area and naturally relates to the states of Washington, Idaho and Montana, it also is traversed by high-voltage transmission lines to serve very substantial loads in central California. To that extent, Oregon looks both north and south in terms of its awareness of regional energy planning, not just to the Bonneville Power Administration service area. In this connection, the role of the state agency is to engage in a balancing effort between the energy consumption needs and the impacts, environmental, economic and otherwise, upon the state by virtue of its hosting the generating facilities involved.

In my opinion, without necessarily endorsing or opposing the specific recommendation made by the Department, an agency such as the Montana State Department of Natural Resources has the capability to make informed recommendations with respect to the power needs not only of the State of Montana, but also of the region surrounding the state.

HEARINGS EXAMINER: Let the record show that Exhibit [illegible] is admitted in evidence, that the last witness testified to. Do you have any exhibits with this witness?

MR. SHERIDAN: No.

HEARINGS EXAMINER: You may cross-examine, Mr. Bellingham.

EXAMINATION OF DIARMUID F. O'SCANNLAIN

Cross, by Applicants,
By Mr. Bellingham:

Q Mr. O'Scannlain -- I hope I pronounced that correctly --

A That's correct, sir.

Q At the top of page 2 you say, nor do I have an opinion with respect to the recommendations it has made in these proceedings, referring to the Montana Department of Natural Resources. That's your statement, isn't it?

A Yes, sir.

Q May I tell you that you seem to be the only person around these proceedings that does not have an opinion, so my congratulations are extended to you. Going further down the statement, page 4, you say, based on your experience in state government in the three capacities previously described, I have reached the conclusion that a state agency with a sufficiently clear mandate can perform the functions of planning for energy needs in conjunction with private utilities whose function it is to meet such needs. You make that statement?

A Yes, sir, that's what I've said.

Q When you say state agency, and applying that to the state of Montana, you're talking, of course, about the Department of Natural Resources, are you not?

A Yes, sir.

Q I mean, that's your function, to be here and testify on behalf of the Department of Natural Resources?

A Yes, sir. As my statement has indicated, I am commenting on the capacity of a state agency to perform the job of planning, and to perform the job of siting of utility facilities, and based on my experience, a state agency has that capability, and can do so.

Q Well, in the context of Montana, you're talking about the Department of Natural Resources, to go back to my original question?

A That's right.

Q Now, do you know much about the Department of Natural Resources of the state of Montana?

A No, I do not.

Q Do you know who's the head of it?

A You mean the staff director?

Q Yes.

A I believe it's Mr. Wicks.

Q Do you know how many employees the Department of Natural Resources has under it?

A No, I do not.

Q Do you know how many -- the number of employees of a similar organization in the state of Oregon has?

A Yes, sir.

Q Do you have a similar organization in the state of Oregon?

A Well, I better explain that the word similar could mean two different things. First, as I've indicated in my prepared testimony, the agency in the state of Oregon that has performed comparable functions to the Department of Natural Resources, was the Oregon Nuclear and Thermal Energy Council. I served on that council for three years. That body has since been absorbed into a new department called the Department of Energy, but the council as a group has continued to function. I am familiar with the number of employees that performed the job of siting, particularly with respect to the Boardman facilities in Oregon, and with respect to the Pebble Springs facility, during the time that I served on the Oregon Nuclear and Thermal Energy Council. I sat at many, many hours of hearings involving testimony from a variety of souces, including the utility companies, as well as the Bonneville Power Administration, and others. In Oregon, the number of staff people were as follows: First, the director, or his title was coordinator, of the Nuclear and Thermal Energy Council was Dr. Kelly Woods, who had a career in service with the General Electric Company having to do with the development of nuclear reactors, and he had retired from that company. He had two principal technical staff assistants, one who was a nuclear physicist who had formerly been employed by the Atomic Energy Commission, and another who had a background in biological sciences, I believe. In addition to that there were several clerical people. So the total number of staff people involved in the Oregon Nuclear and Thermal Energy Council was certainly less than ten, and I think it was probably closer to a half a dozen.

Q Do you know how many sections, divisions, there are in the Montana State Department of Natural Resources?

A No, I do not, sir.

Q And you do not know who the heads of the various divisions are; do you?

A No, sir.

Q And you do not know how many people are employed in these divisions?

A No, I do not.

Q You know very little about the functions of the Department of Natural Resources, do you?

A Well, I think that's pretty evident.

Q You haven't studied this, have you?

A No, nor have I been asked to.

Q You say, you have reached a conclusion that a state agency with a sufficiently clear mandate could perform the functions of planning. What do you mean by that?

A Well, it appears to me that the question has been raised as to whether a state agency has the capacity to do the job of intelligently arriving at decisions with respect to the location of utility generating facilities, and specifically, whether such facilities are needed. Now I am not in a position to say one way or the other with respect to the Colstrip matter, as to whether or not Colstrip 3 and 4 are needed. I think, again, that's repetitious of my prepared testimony. However, the specific question I was asked to address was, to what extent can a state agency perform this kind of job based on the experience of, certainly, Oregon, the only state which I have direct, personal experience with, and I can say, based on that direct, personal experience, not only as the former Public Utility Commissioner of the state, but also as the former director of the Department of Environmental Quality, and as well, during that combined period of service in the McCall Administration, to serve on the Nuclear and Thermal Energy Council, that a state can so structure itself that it can establish an institution which can perform this job, do it intelligently and effectively, staff for it, put itself in the position where it can receive and accept testimony, analyze it independently, retain consultants, do the kind of research that is necessary to do that job.

Q Well, now, in Oregon you're governed by the laws of Oregon, are you not?

A That is true.

Q And by the United States, of course, to the degree that those statutes may be applicable?

A Certainly.

Q As far as Montana is concerned, the Oregon law does not apply, does it?

A Well I hope I didn't mean at any time to infer that it did, sir.

Q No, I don't think you did. I just want to establish for certain. Are you familiar with the Montana law that applies in Montana?

A I have had the occasion in the course of preparation for this testimony to review the Utility Siting Act, but I am not generally familiar with Montana law. I am not admitted to practice in Montana.

Q Well, the Montana law is different from the law in Oregon, is it not?

A Oh, I would generally say that's quite likely.

Q And it's typical of laws between states?

A Yes. That's the inference that I'm trying to communicate.

Q Do you mean by this statement that you think that state agencies should participate with utility companies in their planning, such as load forecasts, economic impacts and rate impacts, exclusive of any applicable statute?

A Well, I think you've said a mouthful, sir. I can say that, certainly in the case of Oregon, that has become fairly routine, and I think it's a matter of legislative discretion. If the legislature decides that it shall be the legislative policy of the state to set up a structure by which the state government puts itself in a review or other participation role with respect to load forecasting, that's a legislative decision.

Q Well, you're not saying, are you, that outside of a statute, you feel that it is the duty of an organization like the Department of Natural Resources to get involved with private utility companies' load forecasting, and economic studies and so forth, are you?

A Well, it all depends. In Oregon, for example, a utility has to demonstrate that it has a need to construct certain facilities, or a need to obtain public utility commissioner approval of a rate increase, and in the course of those proceedings, it's quite routine to review load forecasts, actual consumption levels, and long-range energy planning. I think that's been traditional over the years.

Q Yes, fine, but that's under statute, isn't it?

A Oh, certainly.

Q My question said, exclusive of a statute. You're not implying, I'm sure, that a state agency should get involved with a private utility insofar as their individual forecasting is concerned?

A Well a state agency certainly shouldn't do anything that's ultra vires. I don't think there's -- there's certainly no doubt about that. I may not understand your question, because obviously, a state agency has no power to exceed the legislative authority given to it.

Q So that if a state agency does not have the right to get involved with utility companies' load forecasting under statute, you're not saying that it should get involved outside of any statute?

A I think I agree with you, but I would to have it clearly understood that all we're saying is that a state agency has to conform to the parameters of the legislation which creates it, and which is its command. I am addressing, and the purpose of my testimony, is addressing the general proposition: Is a state capable, through the design of a structure such as a separate agency, or as a division of an agency, to engage in the effort of participating in long-range energy forecasting, general energy planning, and that sort of thing. I would have to say, based on the experience I personally observed, the answer to that question clearly is yes.

Q Well, what you're saying is that if there is a statute that says that the agency has the obligation in conjunction with private utilities to perform these functions, then you say that it should do so; isn't that right?

A Well, certainly, if the legislative mandate to an agency is that it shall do the following things, obviously it should do that. I think in the area of utility siting and long-range energy forecasting, the effort that the agency must engage in is to make a good faith and reasonable review of all the information that is provided to it, either by the utilities, by interested industrial customers, by the general public, by such staff and consultant expertise as the agency itself decides to retain. I think the only point that I'm trying to make here is that an agency can do so if the legislative mandate is there.

Q It has the right to do so, but the right to do so, and the capability to do so, may be two different things; isn't that right?

A Certainly.

Q We know companies who have better capabilities to function, in their corporate capabilities, for example, than others; isn't that right?

A Are you saying that corporations have different earning histories, and different capacities, different capabilities?

Q Yes. Some corporations run more efficiently than others.

A Oh, certainly, yes.

Q I'm talking about capabilities here. That's why some corporations are dissolved, go bankrupt, and so forth; am I right.

A Certainly.

Q And so that you can find a wide variance between state agencies, can't you? Some are more efficient than others?

A Yes, I think that's a general proposition that's true.

Q I mean, it's logic, isn't it? I mean, it's just logical that some may be more capable than others? We're talking about capabilities now, efficiencies, and let's assume that the Oregon agencies that you referred to are capable and efficient. That doesn't necessarily mean that their efficiency and capabilities are transferred to similar organizations, or similar state agencies in other states.

A Well, I certainly never meant to convey that. I do agree with that general proposition. The proposition, however, that my testimony is directed to, is the general one, and that is: May a state agency perform that task if it is properly assigned to it by the legislature, and the answer to that question is yes.

Q Yes, if it has the proper people to do it, isn't that right?

A That would be an element, certainly.

Q Well, if you didn't have the proper people to do it, it couldn't perform, could it?

A Well, the question of the proper people and the size of the staff is something that would have to be addressed on an agency by agency basis, and I think you would have to include in that an analysis of what in-house expertise was available, to what extent public hearings were conducted that presented an opportunity for information to be put into the record which might not have been organized because of a smaller staff. That kind of thing. I think you've got to look at the total picture.

Q Right. And basically, the problem comes down to the personnel, isn't that right? Just as it is in any organization?

A Certainly.

Q On page 5, you indicate that, on line 2, in this connection the role of the state agency is to engage in a balancing effort between the energy consumption needs and the impacts, environmental, economic and otherwise, upon the state by virtue of its hosting the generating facilities involved. What do you mean by that?

A This, again, addresses the general proposition of to what extent a state agency can perform a function of evaluating utility generating siting efforts and what mix of elements goes into that decision; assuming the statute is sufficiently broad, it would mean that the state agency with charge of that responsibility would have to weigh a variety of factors. Again, going back to my own experience in the case of the Nuclear and Thermal Energy Council, there are environmental considerations which are brought to bear by the state agency responsible for that portion of it. There are economic and engineering issues. There are the whole host of questions of what the energy needs of the state are, whether the state is typically an energy consuming or importing state, such as the state of Oregon is, or whether it is an energy exporting state, such as the state of Montana may be. All of these factors, I think, are factors which the agency involved can balance in fulfilling its legislative mandate.

Q And you're not confining your remarks in that connection to any particular state agency, you're viewing state agencies as a group; isn't that right?

A Yes. I'm referring to the concept of a state agency charged with this overall responsibility, yes.

Q Now, you say in a balancing effort. Say that a state agency reviewed the various statutes and decided to oppose a certain site facility, and it did so with every possible means that it had at its disposal. Would you say that it is engaged in a balancing effort, as you have termed it on page 5?

A Well, I have trouble with the introductory part of your question because I suspect there's something in there that I'm not familiar with, or there's a factual background that I may be endorsing which I may not want to endorse. I'll say that I think the agency has a job to do, it can do it, and it should proceed to do so in good faith, and there are examples in other states where this has been done.

Q Toward the end of your statement you say that an agency such as our Montana State Department of Natural Resources has the capability to make informed recommendations. Now, what do you understand the word capability means in that context?

A Well, it's used in the very general sense, and that is that a state agency charged with the very broad responsibility that the statute appears to give in this case -- and again, this is based solely on a very, well, let's see, let's see if I can rephrase that response just slightly. The context of that portion of the statement means that a state agency has the capability to do this if it approaches that responsibility in a good faith effort, and there are examples such as we have in Oregon that show that's true.

Q Well, I think you're using the word capability, line 10, page 5, in the same sense that you would use authority or duty; aren't you?

A The context of that paragraph refers to the question of whether a state agency has the power to do regional planning in terms of load forecast and energy load growth, and that sort of thing. I think as it's clear from line 9, I refer to an agency such as the Montana Department, would have a capability to do that. I am not rendering any kind of an opinion, legal, expert, or otherwise on the question of whether this specific agency has that specific authority, or whether, in fact, it has properly carried it out. I do, however, as I've indicated earlier, address the general proposition: Does the state, and more specifically, an agency within the executive branch of that state, have the capacity to engage in this, and again, based on experience in Oregon, I would have to say the answer is yes.

Q Well, the word capability, I must confess, means something, perhaps, a little different to me than it does to you. The word capability to me means having general efficiency or ability to do a job. Now, that's a far cry from duty or power imposed upon a state agency; would you agree with me on that?

A Well, again, I have specifically refrained from rendering any kind of interpretation as to what the Montana statute requires of that particular state agency, or whether, in fact, that agency has complied with the statutory mandate.

Q I understand, but let's leave out any statute involved, and say that a statute -- well, I can't leave it out entirely -- but say that a statute gives an agency the power and the duty to make recommendations --

A And is adequately funded and staffed to do such --

Q Well, let's just stop there. Let's just stop right there. It has a duty and the power to make recommendations. Okay?

A The hypothetical you are asking me to consider is if a statute is passed by the Montana legislature --

Q No, by any legislature.

A By any legislature, establishes an agency and gives it certain duties --

Q Right.

A -- then what?

Q All right, fine. That doesn't necessarily mean that that agency has the capability of doing it.

A Well, they certainly have the legal capability. There's no question about it.

Q Yes. It has the legal power and duty, does it not?

A Certainly.

Q But as far as efficiency and ability is concerned, that power does not give that agency efficiency and ability, per se, does it?

A Well, I think by adding the terms efficiency and ability, you're bringing in value judgments based on actual performance --

Q That's exactly what I want to do.

A -- and steps taken by the agency after its establishment. The concept which I think is very strongly supported is that if the legislature passes a statute creating an agency and giving it duties and funding it and establishing it and giving it opportunities to conduct hearings and hire a staff, the presumption ought to be that they can do that adequately, subject, obviously, to legal recourse to the courts if it has failed in some way to comply with its legislative mandates.

Q All right, fine. Say that the agency has not staffed itself the way it should, through inefficiency, inability, and so forth, then really it doesn't have the capability in that case to comply with the statute, does it?

A Well, I don't know what the significance of the word capability in that context is. That question is something that would have to be arrived at separately based on an analysis of actual performance.

Q That's right.

A I am not in a position to make that kind of evaluation.

Q We're not asking you to. But if an agency, because of inefficiency and inability, cannot perform, it doesn't have the capability of doing that job, does it?

A Well, I think it probably does have the capability. It probably will have done it very poorly, and probably inadequately, and eventually it may be overturned in the courts if it does not do a good enough job. The concept that I've been addressing here is that if the legislature goes about its business properly, and the agency does as well, then they'll do the job.

Q Yes, you bet. If the agency does it, and if the agency is competent, presumably it'll do the job.

A Presumably, yes.

Q If it's not competent, it won't do the job. It's that simple, isn't it?

A Certainly.

Q It's the same as any organization or company in private life?

A Surely, surely.

Q The mere fact that a state agency is set up certainly does not, in itself, prove its capability or its competency, does it?

A Well, again, it depends on what the legislative mandate to that agency is, and also the degree to which it is staffed, and the diligence with which it pursues its duties.

Q Oh, absolutely. But the mere fact that an agency is set up by statute, in and of itself, doesn't mean that that agency is going to carry out the mandates of that statute in a capable and competent manner, does it?

A Well, it would seem to me that if that's the result, and if it's sufficiently evident to the chief executive of the state, then the chief executive will make certain personnel changes designed to bring about the results you're looking for.

Q Mr. O'Scannlain, you testify like a typical lawyer. Could you answer my question yes or no. I think it's capable of being answered yes or no. Do you remember my question?

A I certainly do, and I've done my very best to try to answer it.

Q Do you think you can answer it with a yes or no answer?

A No, because of the way you phrased it, sir.

Q Well, if you were in my place, how would you have phrased it? Do you have any idea?

A Well, I'm here simply to address the question of whether an agency has this kind of capability.

MR. SHERIDAN: We might be able to give Mr. Bellingham some help, Mr. Hearings Officer.

MR. BELLINGHAM: Pardon me?

HEARINGS EXAMINER: Will someone make an objection so I can overrule them or something.

MR. SHERIDAN: I'll object on the basis of repetition.

HEARINGS EXAMINER: Sustained.

MR. BELLINGHAM: I have no further questions.

MR. SHERIDAN: Nothing further, thank you.

HEARINGS EXAMINER: Very well, you're excused, sir.

(WITNESS IS EXCUSED.)

HEARINGS EXAMINER: Next witness?

MR. SHERIDAN: Gary Wicks.

GARY J. WICKS, called as a witness by the Department of Natural Resources and Conservation, having been first duly sworn upon his oath, both as to his written direct testimony and as to the oral testimony to follow, was examined and testified as follows:

MR. SHERIDAN: At this time the Department of Natural Resources tenders Gary Wicks for cross-examination and offers his statement in evidence.

(THE WRITTEN DIRECT TESTIMONY OF MR. GARY J. WICKS WAS DIRECTED TO BE INSERTED AT THIS POINT.)

STATEMENT OF GARY J. WICKS
DIRECTOR, DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

Biographical Data: Born: Mullan, Idaho on December 13, 1939. USAF, 1961-1964, BA History and Political Science, University of Montana, 1967. Course work for MBA, U of M, completed in 1969. After completing my undergraduate and graduate education, I served as Administrative Assistant to the Governor of Montana from 1969 until 1971, responsible for budgetary, natural resources and environmental matters. I was appointed in 1971 as Director of the Department of Natural Resources and Conservation on its creation and reappointed to that position in 1973. I am a member of the Montana Energy Advisory Council. I am the Governor's Alternate to the Western Governors' Regional Energy Policy Office.

I begin with some perspectives regarding the future of Montana and its relationship to coal development in order to put into context the recommendations which I urge in this proceeding as Director of the Department of Natural Resources and Conservation.

First, coal presently is this nation's most plentiful and available fossil fuel. It will play an increasingly significant role as this nation attempts to come to grips with the energy problems we all face. Presidential policy and federal law mandate this result.

Second, Montana has more coal by far than any other state. Of the 434 billion tons of coal reserve base in the United States, 107 billion tons, or approximately one-fourth of the total, are located in Montana.

Third, with coal reserves of such magnitude, Montana has a responsibility to the rest of the nation to assist in solving energy problems by making coal available.

Fourth, Montana is meeting its responsibilites to Montanans and to the nation as expeditiously as possible. In 1969, coal production in the state was 1 million tons. By 1975, the figure had increased 2,050% to approximately 21.5 million tons. By 1980, without supplying Montana's coal to Colstrip Units 3 and 4 and without any additional contracts for sale, that figure will be close to 38 million tons per year. In 1975, 94% was shipped out of state; in 1980, 91% will be exported.

Coal from Montana will be providing electricity for Detroit, Austin, Minneapolis, Chicago, etc. And that coal will be provided at a cost considerably cheaper than that of any other available fuel source, despite the long shipping distances.

Fifth, many other coal conversion facilities are being considered for Montana. Burlington Northern has proposed a coal based plant which could produce fertilizer, methyl and diesel fuel in the Circle area. The Federal Power Commission projects for planning purposes 25,000 MW of additional coal generating capacity to be required along the Missouri River alone between 1985-2000. The Federal Energy Administration projects that 19,400 MW additional capacity in Montana, North Dakota, and Wyoming would be most appropriate for 1975-2000 planning purposes, in addition to several coal gasification facilities.

Although all the development projected will probably not become a reality for a number of reasons, it is obvious that Montana will have the opportunity and responsibility to consider a multitude of proposals.

Sixth, as I have argued in the Legislature and in other forums, I oppose the adoption of a so-called "export only" policy. It has a doubtful legal basis. Moreover, I believe such a policy could be inimical to the best interests of Montana and the nation.

Instead, it is my belief that conversion facilities must be evaluated for specific impacts and benefits as required by what is now called the Major Facility Siting Act, formerly the Utility Siting Act. Therefore, a Departmental recommendation on any application should be determined by whether a proposed project meets the requirements of the law; if so, then the best interests of the state, as defined by the legislature, will be served, and the project should be approved.

In the application currently before the Board, however, the Department has been unable to conclude that the major provisions of the law can be met or that approval would be in the best interests of Montana.

The Major Facility Siting Law is fairly inflexible as to what the findings of the Board must be before a certificate of environmental compatibility and public need can be issued. Briefly, the Board ". . . shall find and determine:

"(a) the basis of the need for the facility;

"(b) the nature of the probable environmental impact;

"(c) that the facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives . . .

"(g) that the facility will serve the public interest, convenience and necessity."

The requirement to certify the "basis of the need for the facility " does not mean to me, despite what some Montanans have contended, that the Board can ignore the "energy" needs of neighboring states. Establishing a demand for energy in neighboring states does not in itself mean, however, that the requirements of this provision of the law have been met. Instead, we must look to a broader consideration of need, to whether the citizens of the state of Montana, "need" the facility, considering both the energy needs of the region and state and the overall costs and benefits and the environmental impacts and the availability of alternatives which will have a lesser environmental and social impact.

For instance, if reasonable alternatives for providing the energy to the state and region exist, and these alternatives more nearly represent the "minimum adverse effects on the environment," then the state of Montana does not need the facility proposed - - put differently, the "basis of the need for a facility" does not exist.

The Department of Natural Resources and Conservation must operate, has operated, and will continue to operate as required by law in compliance with the policy that presumes all applications or requests for action to the Department are made in good faith and will comply with the law. The evidence generated by an evaluation normally supports that presumption, and the action is approved. Hence the Department has, over the past few years, approved or recommended for approval thousands of water permits, dozens of timber sales, numerous easement requests, etc. In fact, of the 19 applications received under the Utility Siting Act since 1973, the Department has recommended approval of no less than 15, with 2 still pending.

The law under which the application was filed in this proceeding required the Department to evaluate alternatives, to compare impacts, and to examine the basis of the need; it was the law that gave shape to the methodology for study ultimately adopted.

And, from the time the application was made until the results of the studies became known, the presumption of compliance held, the application was treated like all applications, and a recommendation of approval was anticipated.

In fact, the final decision to recommend denial was not made until the end of the time period allowed for receipt of evidence and comments from the public and other interested parties relative to the draft environmental impact statement.

Based on the evidence contained in that environmental impact statement and other information submitted, the Department was not convinced in January of 1975 that the applicants could carry the burden of proof necessary to the findings required of the Board by law if the application were to be approved.

Since January 1975, these doubts have become convictions, and no single event, no combination of occurrences, no emerging trend would weaken the Department's original conclusion. To the contrary, most subsequent evidence and developments have verified and strengthened our recommendation that the application be denied.

(1) Demand for Electricity The trend toward lower rates of growth in the demand for electricity is growing stronger.

Over the past decade electrical usage had grown at a rate of 7 percent annually. However, for the first time since 1945, electrical usage showed a slight overall decline from 1973 to 1974. In examining whether this reduction of load growth could reflect an atypical situation, recent studies continue to project a continued rate of growth far below the experience of the past. We are not here to plan for the past. We must anticipate the future by what it projects.

Continuing studies project lower than previously expected electricity demand, cutbacks in utility construction plans, and substantial excess generating capacity.

Reasons for the slowdown appear to include conservation efforts, the impact of increased relative electricity prices, and general economic factors related to one of the most severe recessionary periods since the 1930's.

In Montana, we are aware of the probability of further reductions in natural gas deliveries from Canada, and this likelihood is an obvious concern shared by the Department and state government. A gasification task force, therefore, including the present applicants' representative, has been appointed to explore coal gasification as an alternative to the declining availability of natural gas. The Department will be participating in studies to determine the viability and suitability of this approach. Other alternatives, such as increasing exploration and securing natural gas from Alaska via a pipeline are being pursued. At the insistence of the Montana Public Service Commission, conservation plans have been developed by Montana industries dependent on natural gas, with significant results projected - up to 15% savings. The Governor of Montana, along with a majority of the Western Governors' Regional Energy Policy Office members, has urged federal financial assistance for demonstration plants to evaluate gasification and other coal conversion technologies.

Problems anticipated with natural gas supply in Montana cannot be confused with the present application before the Board. In June 1973, when that application was filed, there was no stated commitment to use any electricity from Colstrip Units 3 and 4 as a substitute for natural gas. Since that time, despite the growing awareness of the natural gas problem, no such commitment has been made--and with some logic. The amount of electricity from Colstrip Units 3 and 4 reserved for use by Montana Power Company, 30%, is supposedly earmarked for normal projected load growth, and could not be used for massive conversion from natural gas unless projections of normal load growth were and are overstated or normal electrical loads could be met by alternative means. If any of the remaining 70% earmarked for out-of-state use could instead be directed to conversions from natural gas in Montana, then serious questions must be raised as to the supposed need for power in regions outside Montana, the dates when those demand projections would become a reality, or the alternatives available to meet the demands.

Problems of natural gas supply in Montana and their effect on electrical loads must be addressed by sound planning for other alternatives, and these problems should not be a consideration in these hearings.

(2) Availability of Reasonable Alternatives. More and more evidence continues to accumulate showing that alternatives to the proposed project are reasonable from an economic point of view and will have significantly less adverse impact on and in Montana.

In a comparison among the costs of shipping coal by rail or slurry and transporting electricity by transmission lines, it has been found that, with blocks of power of 1600 megawatts or less, shipping by rail from coal mine to load center generating facilities would be considerably cheaper than using transmission lines, for all distances analyzed. With much larger power blocks, above 3,200 MW, transmission can become more economically competitive. Coal shipment by slurry pipeline to load center generation was by far the cheapest alternative in all cases, at all distances, and at all loads.

The alternative of conservation is becoming increasingly more apparent as an effective means of reducing wasteful demand. In 1975, energy conservation by the federal government resulted in 28% less consumption than that during the same period in 1973. Decreased energy consumption of this magnitude may not be necessary in the Pacific Northwest, but a reduction in demand in this region of 5-6% would eliminate the need for the energy earmarked for out-of-state from Units 3 and 4.

I am disturbed by the fact that, despite their claim that a severe power shortage could develop, the applicants have steadfastly refused to actively pursue these alternatives and others suggested, either before or after the Department made its recommendation. There has been no major effort at conservation, no attempt to restructure rates to make conservation more attractive, no acceleration of construction schedules for plants already under construction, no reversal of decisions to delay some construction schedules for lack of demand, no consideration of or planning for a small plant which could provide for at least Montana's energy demands, and no discussions with regulatory agencies in other states to provide facilities in line with their energy demands should the proposed facilities be denied. I do not believe that this refusal to pursue alternatives is due to ill will, bad faith or negligent planning on the part of the applicants. But there must be some explanation; and the most logical one is that the demand for electricity in the future will not be - as the applicants would have us believe - an inflexible repetition of the past. It is apparent that the applicants have reason to believe, as I do, that future demand for all applicants can be met without the 1400 megawatts which would be generated by Colstrip Units 3 and 4.

(3) Probable Impacts of the Proposed Facility and the Alternatives. As interest in coal development grows, more studies are being completed which compare the environmental impacts of the different energy resource utilization alternatives in the western United States. More than one study has concluded that surface mining coal in Montana and transporting it by either rail or slurry for load-center generation would create fewer over-all impacts than does the alternative of mine-mouth generation plus long distance transmission. With mine-mouth generation, there is not only more adverse environmental impact in the aggregate, but that adversity also is concentrated at the resource site.

The alternative of transporting the coal to load centers generally is more energy-efficient, due to resistive losses associated with long distance transmission lines.

It is important to note that one of the major benefits - jobs - which the Department suggested would result from shipment by rail is becoming a reality. For instance, because of the increasing delivery of coal out of the state, Burlington Northern is planning to build a coal car repair and maintenance shop in Laurel. By the fourth quarter of 1976, 320 new, high-paying, long-term jobs should be open to Montanans.

The positive aspects of conservation are fairly obvious --no environmental impact. And, conservation can be realized without inhibiting healthy economic growth, including improvement in the standard of living.

Irrespective of whether the environmental effects of the proposed facility eventually will succeed in meeting environmental standards, the generation of an additional 1400 MW of power at Colstrip, as proposed, will cause more than 134 million pounds of SO_2 and 5 million pounds of particulates to be emitted each year. We are certain that these pollutants will damage existing vegetation in the area and affect the regeneration of certain species used to reclaim the land disturbed by mining.

We are only beginning to understand the full relationship between environmental pollution and human health. In August of last year, high correlations were found between areas of high pollution and the incidence of certain cancers in the United States. We know that some carcinogens will be emitted from the Colstrip Units 3 and 4 facility. We do not know all of the long-term effects of even small dosages of those carcinogens on human health.

There is no reason why the people of Montana should become involuntary "test cases." Montanans, especially the people in Rosebud County, should not be forced to assume unnecessary risks to their health.

We also have to consider the commitment of natural resources directly associated with the generation of 1400 MW of power that would no longer be available for other uses. More than 14,000 acres of land for transmission lines, 23,500 acre-feet of water every year, Montana's air, and any vegetation damaged by the facility would be part of that commitment. Even the federal government is starting to recognize that these kinds of commitments may represent an unfair burden to impose on the coal-producing states, so that the fullest consideration should be given to locating energy conversion facilities in regions better supplied with water, labor, industrial facilities and social support systems. "If state and local governments do not anticipate the consequences of energy development, and if they do not exert the leverage of water rights

> and other governmental powers to protect non-energy water uses, there will undoubtedly be local dislocations, both economic and social, as traditional agriculture and related business activities are preempted."
>
> One more vital observation. The applicants have not demonstrated that the proposed facility will provide electricity to Montanans at a rate cheaper than would result from implementation of the alternatives suggested. This would seem to be an absolute requirement.

Clearly, the alternatives to the proposed facility require much more consideration by the applicants than has been accorded them to date.

In summary, then, in 1975, when the recommendation was issued, the Department was not persuaded that the proposed facilities would serve the public interest, convenience and necessity. Under the siting act, certification must be denied if the public interest, convenience and necessity criterion is not met. Subsequent evidence regarding demand for electricity, the availability of reasonable alternatives, and the minimization of impacts has persuaded the Department: the public interest, convenience and necessity can only be met by denying this application.

I close this testimony with a few additional considerations:

(1) Opposition to the specific application now before the Board is perfectly consistent with the Department's actions in support of economic growth, increased employment opportunities for Montanans, and the sound development of Montana's resources. In fact, the statutory mandates under

which the Department operates require that plans be developed and actions taken to promote resource utilization.

In accordance with those mandates and policy, the Department has sold almost 95 million board feet of timber since 1971; a forest work program has been initiated to give over 100 Montanans temporary employment and improve our timber resources; individuals and corporations are being assisted in the management of private timberlands.

The Department has actively sought and helped secure the locating in Montana of a multi-million dollar weather modification research project, which has brought immediate economic benefits to Miles City and may bring tremendous returns when the techniques of cloud seeding to increase crop production are better understood.

With regard to water development, the Department has, since 1973, issued over 5,000 permits for water use totaling 266,000 acre-feet, much of which will be used for irrigation.

Two programs conceived by the Department to stimulate resource development, the Technical Assistance Program and the Renewable Resource Development Act, have been approved by the legislature and will soon be implemented. And, plans for alternative uses of water in the Yellowstone Basin and elsewhere will be presented to the 1977 legislative session for approval.

Opposition to the specific application now before the Board is also perfectly consistent with intelligent energy development. We have acknowledged Montana's obligation to share energy resources with the nation, and we have noted that this state has in fact been, and will continue to be meeting that obligation through the exportation of far more energy, in various forms, than is consumed.

And opposition to the specific application now before the Board is perfectly consistent with the siting of some additional coal-fired generating plants in Montana when and where necessary. Certainly if the demand for electricity will exceed available resources in this state in the future, generating facilities here may make sense. They should be evaluated expeditiously, with any other reasonable alternatives to meet that demand.

By avoiding at this time the unnecessary commitment of resources required by plants generating 1400 MW, this state may be able to capitalize on several other developments occurring with regard to energy.

(a) The technology for coal conversion is moving forward rapidly, especially with federal funds for research now and possibly for demonstration plants in the near future. For instance, MHD (magnetohydrodynamics) offers exciting possibilities for more efficient conversion of coal, with far less environmental impact. With an efficiency rating of above 50%, as opposed to a maximum of about 35% for conventional steam fuel generators, MHD generation of 1400 MW would save 60 million tons of coal over a 30-year period. And, less land would be stripped, less water would be needed, and lesser amounts of pollutants would be emitted in producing the same amount of electricity. Although more research and demonstration plants are needed, MHD should be available for commercial use in the mid-1980's. Through the MHD Institute established in Butte, a major effort has been initiated to build a component plant and proceed to large-scale tests.

Solar, wind, and other renewable resource technologies are receiving far more research monies and should begin making an impact on energy production within the next two decades. The Department administers a program established by the 1975 legislature to provide up to 1.7 million dollars for research and demonstration grants in this biennium.

(b) The technology for removal of SO_2, particulates and other pollutants from huge power plants like those proposed at Colstrip, is improving through significant national efforts. Within ten years, it is reasonable to expect that removal efficiences will be considerably improved, and then the risk present to the environment and to humans can be reduced to a level that is tolerable.

(c) The participation of states in regional planning to meet energy needs, to share the impacts and risks of energy production, and to equitably distribute the benefits is not now a reality. However, progress is being made. The Western Governors' Regional Energy Policy Office has been formed to develop common approaches to energy development. In addition, initial discussions on energy have been held with states of the Pacific

Northwest, with prospects for more formal exchanges. But these are only a beginning. Clearly, regional planning involving the people of the various states must play a role in solving our energy problems. If these problems are instead addressed unilaterally by utility companies or the federal government, the solutions may well not be compatible with what the people desire.

Considering the likelihood and magnitude of such anticipated changes in technologies and the emergence of new approaches to planning, together with the evidence mentioned earlier and to be presented at this hearing, it does not seem either necessary or reasonable to commit Montana irreversibly to the proposed facility.

A smaller facility, using the old technologies and based on the old methods of planning for energy development, or other alternatives like conservation may be required to answer the power needs of Montana for the near future. But to allow 1400 MW, given the specifics of this application, is to perpetuate a policy of resource utilization which is unjustified and a technology which will undoubtedly become obsolete.

(2) Finally, this application is obviously the first major test of what has become the Major Facility Siting Act. We believe that all interested parties should be accorded a fair hearing under the law; we have made every effort to ensure that this objective is met.

Mistakes in procedure have been made; I do not expect most of them to be repeated. The hearings, for a multitude of reasons, have taken too long; we know now how they can be shortened and decisions made more expeditiously.

These difficulties, however, cannot be allowed to overshadow the basic issue at stake here - whether the people of this state, by law and through their elected and appointed officials, will determine the major decisions that shape their future.

If the Board demands consideration of alternatives, if it demands that the best technology be used, if it demands that impacts be minimized, and if it demands that the proposal be in the best interests of Montana, then the principle will be established, and the highest standard will be set for future applicants and for coal development in this state.

EXAMINATION OF GARY J. WICKS

Cross, by Applicants,

By Mr. Ross:

Q Gary, to start with, could you give us a little bit more of your background, particularly where you've lived, where you've gone to school?

A Certainly. I attended grade school in Alberta, Canada, and I lived in Canada for, I think, about 17 or 18 years.

Q Where have you done your college work?

A University of Montana.

Q Exclusively?

A Right. Well, except for some courses I picked up when I was in the Air Force, through correspondence from the University of Montana and a college in Maine.

Q When did you come to Montana?

A 1961 was the first time that I came here, and joined the service then.

Q Then you haven't lived in Montana since '61. You had an interlude in the service I take it?

A I had four years in the service, yes.

Q And then after the service you came back to Montana, is that right?

A That's correct.

Q And you've been here ever since then?

A Right.

Q What year did you come back to Montana from the service?

A January of 1965.

Q As Director of the Department of Natural Resources, you know that, and as a party in this proceeding, you know that you're not to have ex parte communications with the board or any of the board members; do you know that?

A Yes.

Q Have you ever had any ex parte communications with the board as a whole, or any individual board member, with regard to Colstrip 3 and 4?

A The only ex parte communications that I recall are ones dealing with the status of the hearings, the answers to questions such as when the -- when we anticipated the hearings would be done, how they're going, and that kind of thing.

Q You have never given them your views on what the law or the facts are of the Colstrip 3 and 4 cases?

A Certainly we've given our view of what the law is, yes. There's no way to avoid the --

Q Have you ever advised the Board of Natural Resources on what the Department's position is, interpreting the Board of Health's responsibilities in this case?

A Yes. Not me personally, but our legal counsel has, yes.

Q You start out your statement by giving us what you say, on page 1, line 17, some perspectives regarding Montana's future and its relationship to coal development in order to put your recommendations into context. Looking at your first perspective, I take it there that you concede that we do face some energy problems; is that right?

A Certainly.

Q And also you state there in that first perspective that you think coal has got to play a part in coming to grips with that energy problem; is that right?

A That's correct.

Q And in the third one you seem to indicate that you think Montana has the responsibility to the rest of the nation to help solve this energy problem; isn't that right?

A That's what the statement says, yes.

Q In the fourth perspective, at lines 8 and 9, you give us some figures on coal production in Montana, and you indicate there that it's increased by some 2,050%; in 1975 we have 21.5 million tons of coal. If I could ask you to go up to the drawing board there, I'd kind of like to look at this in another perspective.

(MR. ROSS GOES TO DRAWING BOARD AND POSTS TO IT.)

Q In your second perspective, you indicate that Montana has 107 billion tons of coal; isn't that correct?

A The statement was that we have 107 billion tons of the coal reserve base.

Q And then in part 4, you indicate that in 1975, we mined approximately 21 1/2 million tons of coal.

A That's correct.

Q Do you have any idea, if we presume that we were to continue to mine approximately 21,500,000 tons of coal, how many years it would take to use up that coal in Montana?

A I don't know what that figure would come out to.

Q Would it surprise you if it would come out to approximately 5,000 years?

A Mr. Ross, you're making what I think is an untenable assumption, and that is that we're only going to use 21 million tons of coal, or produce 21 million tons of coal in Montana. As I indicated in my statement, we anticipate that, with no new contracts, by 1980 we'll be mining 38 million tons of coal. The Northern Great Plains Resource Program predicts that at a high level of development, by the year 2000 we'll be mining 393 million tons of coal per year. That considerably shortens the time period you mentioned.

Q Would it surprise you, assuming your figure of 38 thousand, that it still is between three and four thousand years before we can use up our coal in Montana?

A 38 million.

Q 38 million. It would still come out between three and four thousand years before we'd use all that coal?

A If that's the computation, it wouldn't surprise me.

Q Aren't you also aware that there's a possibility that that coal production may decrease because of such things as the increased use of nuclear?

A I have mixed information on that.

Q You also indicate in your statement that in the future you expect greater efficiencies of coal conversion, which would use less coal. Wouldn't that tend to have Montana use less coal in the future, mine less coal?

A I think the important point made with regard to efficiency is that we will extend even further those reserves to make more energy available to future generations of Americans.

Q Well, my question was, don't you think that may be a factor in using less coal, mining less coal in Montana?

A Yes, it may be.

Q Okay. And don't you also think the fact that, with the advance of scrubber technology, other states may use their own high sulfur coal, and will mine less coal in Montana?

A That is a possibility, but unlikely.

Q Why do you think it's unlikely that other states will use their own high sulfur coal with scrubbers?

A Because in many of the areas that I'm aware of that are presently using Montana coal, it is, even as compared to coal mined from closer areas, more competitive.

Q Let's go to your fifth perspective, and you say at line 19 and 20 that many other coal conversion facilities are being considered in Montana.

A Yes.

Q Can you tell me what private companies are considering coal conversion facilities in Montana?

A We have had discussions with Northern Natural Gas over the past couple of years about the possibility of a gasification plant being built in Montana. You, in your own ten year report, filed annually, indicate the possibility of building a gasification plant in the state of Montana. And we've had -- I don't recall the names -- but we've had many discussions with people that are considering building a gasification plant in the state of Montana.

Q Do you know what the lead time is to build a generation plant?

A What size and what kind?

Q Say a generation plant, a 500 megawatt electric generation plant in the state of Montana.

A I would say that the construction time as we indicate it -- or, pardon me, as you indicate it in your information submitted in the draft -- was four years, and the possibility of an additional study period of two years.

Q Does it surprise you that the Montana Power Company now considers it would take a ten year lead time to build a plant in Montana, including the review under the siting act?

A That would surprise me.

Q Even in view of how long these hearings have gone on?

A Yes.

Q Has anybody filed an application to build any coal conversion plant in Montana?

A Nobody has specifically filed. We do have a contract, as I indicated in my statement, with Burlington Northern to begin studies on a coal to fertilizer conversion facility.

Q Do you know for a fact that anybody is going to file an application?

A I do not know for a fact, but we anticipate that they will.

Q On what basis do you anticipate that they will?

A Well, the contract which we signed with Burlington Northern is going to require them to put up an amount of money to conduct these studies, and certainly it appears to me that they wouldn't be going into this unless there were some likelihood that they intended to file in the future.

Q Are you aware that both the Montana-Dakota Utilities and Basin Electric Coop have gone out of state to build generation plants?

A I'm aware of it.

Q In your statement you list these six perspectives which you say put into context your recommendations. I see nothing in your statement with regard to other perspectives about Montana coal development. For example, there's nothing in your statement, is there, about the economy in Montana, and what coal development -- how it may benefit jobs and the economy in Montana.

A Is that a question?

Q That's a question. Is there anything in your statement where you state the perspectives of your recommendations? Do you include in any of those perspectives the economy and jobs in Montana?

A Certainly.

Q In what perspective?

A As I indicated, I believe, on page 11, that we are observing an increase in jobs through the shipping of coal out of the state. That's one of the perspectives --

Q That wasn't my question. I asked if in the six perspectives you list, which you state are the contexts for your recommendations, do you include in any of those a discussion of the economy and jobs in Montana?

MR. SHERIDAN: I'll object to Mr. Ross' characterization of what his question was, and request that the witness be allowed to answer the question as framed, if it's a question at all. It's nothing more than mere argument.

HEARINGS EXAMINER: Okay. You can ask the question again to be sure we're all clear on it.

Q In the six perspectives which you list on page 1 and 2 of your statement, do you include a discussion of the economy and jobs in Montana as a perspective for coal development?

A There is no specific reference to it in those statements; however, implied with an increase in coal production, is an increase in the amount of jobs available for mining and shipping of coal.

Q Is there anything in those six perspectives about what will happen if Colstrip 3 and 4 is not built?

A That is not the -- our department's position is that it should not be built, and we're dealing with the reasons why it should not.

Q Well, I understand that, but what I want to know, is there anything in your perspectives in consideration of Colstrip 3 and 4 that would indicate what will happen if 3 and 4 are not built?

A There is nothing in the six perspectives I list; however, there is some information later on in the statement that I referred to earlier.

Q Is there anything in your perspectives on which you put the context of your recommendations with regard to regional cooperation?

A That comes later in the statement.

Q Well, don't you think that your recommendations should have been made in the context of regional cooperation?

A It was.

Q On page 3, at line 11, you seem to indicate that specific application should be evaluated on its specific circumstances. You say specific impacts and benefits. Would you also believe that each application should be evaluated on the specific needs of the applicants?

A No. Well, let me, before I'll retract that statement, ask you as to what are you talking about needs - energy needs?

Q Yes.

A Then the answer is, as I indicated elsewhere when we discussed the requirement in the law that the board shall find the basis of the need for the facility, that we have to look just beyond the specific limits of Montana, and perhaps beyond the specific limits of the applicant companies.

Q Are you saying that, with regard to demand for energy as that relates to need, that we should look specifically at the applicants' service areas?

A I'm saying that is one of the most important considerations, yes. They're the ones that are applying for the power.

Q On line 21 you state that you are unable to conclude that the major provisions of the law have been met in this case. Which major provisions are you referring to?

A I believe the ones that follow on page 4 of the statement.

Q You state on line 24 that those provisions are fairly inflexible. What do you mean by fairly inflexible?

A I mean that the requirements that the board shall find.

Q Do you think that that contemplates that the board shall find a specific set of circumstances or that the board has to look to a specific standard?

A I think that it -- the term inflexible, if the legislature had wanted flexibility built into the law, they could have easily put a may in there.

Q With regard to your discussion of need on page 3 --

A Yes?

Q What specific set of circumstances do you think the board shall find in order to find the basis of the need?

A On page 3?

Q On page 4, excuse me. Beginning at line 9.

A Would you repeat that question?

Q Yes. What specific set of circumstances do you think the board must find in order to meet the definition of need as you state it there?

A That the facility does represent the minimum adverse environmental impact, considering the state of available technology; that the facility will serve the public interest, convenience and necessity; and also have to determine the nature of the probable environmental impact.

Q Well, aren't each of these items separate findings as set forth in the act?

A They are separate findings, but I believe that they're all part of the requirement of the law that they find the basis of the need for the facility.

Q Do you have any authority to support that contention that all of these things are part of a need?

A We have legal memoranda to that effect.

Q From whom are these legal memoranda?

A Counsel.

Q Your own department counsel?

A Counsel of our department and retained counsel.

Q Do you have any other authority outside of your own counsel?

A No.

Q Couldn't this then be classified as your opinion and that of your counsel on what -- how need is defined?

A Certainly.

Q Is this definition of need which you've explained, is that the same definition that you used in evaluating the Colstrip 3 and 4 application?

A Do you mean in our draft environmental impact statement?

Q Yes.

A Yes, it roughly complies with the definition we used.

Q At line 12, you state that --

A What page?

Q Page 4, line 12 -- that even if a demand for energy is established, it wouldn't necessarily meet the provisions of the law with regard to need; is that what you're saying there?

A That's correct.

Q Well, on page 15 of your statement, at line 7, you say, certainly if demand for electricity will exceed available resources in this state in the future, generating facilities may make sense. Why would they make sense in the future if demand for electricity exceeds resources, if they don't in this case?

A As I indicated in the -- page 3, I believe -- the applications and circumstances of a particular problem have to be evaluated separately, and it could well be, as I say in my statement, on page 15, that the facilities may make sense in the future.

Q As I understand it now, your definition of need includes a broad spectrum of considerations. For example, we have to include the overall costs and benefits, we have to include consideration of alternatives and environmental and social impacts. Now can you tell me how we consider all of those things to determine whether we meet need?

A We did consider them in our draft environmental impact statement, and the final one.

Q Well, how do you know what all of the costs and benefits of this project are?

A By examining them.

Q What do you do? Throw all of these things into a computer?

A No.

Q Do you throw them all onto a scale?

A No.

Q Well, how do you come up with a decision, then, whether you meet the criteria of need?

A I think you have to weigh all these things, and come up with an overall judgment as to whether or not the requirement for the basis of the need is met.

Q Well, isn't that a pretty subjective decision of need as you've given it?

A Not really.

Q Well, how do you quantify all of the costs and benefits, for example, of this project, to determine whether need is met?

A You can't, of course, quantify all the costs and benefits, but it's certainly easier to quantify some of them. We know how many acres of land will be disturbed by the facility. We know how many -- what the pollutant level will probably be. On the other hand, we know how many jobs will probably be created. Those types of things are quantifiable.

Q Let me ask you this hypothetical. Do you think a company would make an application under the siting act if they felt that they had a demand for the energy product? They could establish that easily. Do you think they would make an application in view of your definition of need?

A Certainly.

Q In other words, they would file their application and demonstrate that they needed the energy, but then they would leave it up to your department to determine whether, for example, what the costs and benefits of the project were, and all of these other subjective decisions?

A Well, regardless of whether or not they would, these aren't really my decisions. We only recommend. It's the board's decision as to whether or not we've made a case on this and, of course, the law requires that we do this. Whether or not the company felt they should apply under those circumstances is something they would have to determine.

Q In considering the costs and benefits of the project, did you take into consideration such things as the jobs that would be generated for Northern Cheyenne Indians?

A No.

Q Are you aware that a Mr. Robinson, who is a member of the Northern Cheyenne tribe, testified at this hearing earlier in the week and stated that Colstrip 3 and 4 would be a benefit to him and to the Northern Cheyenne tribe?

A No, I'm not aware of that.

Q Are you aware that a county commissioner testified here this afternoon that this project should be built because it would provide tax benefits to his county and the state of Montana?

A I'm not surprised.

Q Did you consider these type of benefits in making your decision whether the project meets needs?

A As you well know, Mr. Ross, in the draft environmental impact statement, those kinds of things were considered.

Q Well, how did you determine that these sort of benefits did not outweigh the cost?

A How did we determine that? By looking at the other costs and benefits and those as well. There is no question that there will be some tax benefits to the state of Montana if 3 and 4 are built.

Q Again, isn't that a subjective decision?

A It is a decision that I have to make, or had to make, after looking at what I thought was the best evidence we had, yes.

Q Do I understand you to say you looked at all of these things, and then made the decision; is that correct?

A I looked at the information provided me from the -- by the Energy Planning Division, yes.

Q Are you aware of all of the evidence in this record on the benefits of this project?

A Not all the evidence, no.

Q If you were to review that evidence, do you think there's a possibility that you might find that the benefits of the project outweigh the cost?

A I doubt it. However, the evidence that is being considered is before the board. They will have the opportunity to weigh the evidence.

Q On page 4, item B indicates that the board must find the nature of the probable environmental impact. Don't you think the way that is stated in the law that some environmental impact is contemplated under the law?

A Certainly.

Q And in item C, where it states that the facility represents the minimal adverse impact, don't you think the second clause where it says, considering the state of available technology and the nature of economics, the law contemplates that the state of technology must be considered?

A Certainly.

Q And likewise, that economics must be considered?

A Yes.

Q And the final item there on page 4, where it says that the facility serves the public interest, convenience and necessity, are you aware that there have been a lot of public witnesses in this hearing testify that this facility does, in fact, serve the public interest, convenience and necessity?

A I'm not aware of witnesses that specifically testified to that, no.

Q Are you aware that witnesses, for example, testified that Colstrip 3 and 4 would provide energy for environmental clean-up?

A No, I'm not aware of that testimony here, but I have -- I believe it was mentioned in your application.

Q Are you aware that witnesses have testified here that it would provide energy for sprinkler irrigation?

A Yes.

Q Are you aware that witnesses have testified here that it would provide jobs in Montana?

A Yes.

Q Well, what about these benefits. Again, you don't think they outweigh the costs?

A I don't think that your statements necessarily relate. You are saying that there is a need for energy, which the Department freely acknowledges that there is, and if this energy can be provided, these same jobs might be made available as they are right now. The Department is not denying that energy might be needed by the applicant.

Q On page 5, at line 8, you talk about your department's review of other applications under the siting act.

A Correct.

Q And you indicate that the Department has recommended disapproval on two applications. Which two were those?

A I didn't say that in my statement, Mr. Ross.

Q Okay. Has the Department recommended approval of all applications under the siting act?

A Obviously we haven't recommended approval of this one.

Q Have there been any others which you have not recommended approval as requested by the applicants?

A We recommended approval of a 230 KV line from Colstrip to Broadview. We took exception with the upgrading of that line at this time.

Q Isn't it true that in your recommendations on that 230 double circuit line, you made the recommendation to wait to determine the type of line that should be built until a decision was made on units 3 and 4?

A If I recall correctly, we recommended that it would be okay to go ahead and build a 230 KV line, but to build it to the specifications of a 500 KV line should wait for the decision on 3 and 4.

Q Do you remember in part of your recommendation you indicated you thought once approval was received, that right of way could be obtained in approximately a month?

A I don't recall that statement.

Q Well, assuming that is the case, would it surprise you that, rather than a month, a year and a half later all the right of way is still not obtained?

A No, it wouldn't surprise me.

Q If the Board of Natural Resources had adopted the Department's recommendation on the 230 double circuit line, which was to wait until a decision was made on units 3 and 4, don't you think we would now be facing a real problem of getting power out of units 1 and 2 in the summer of '76?

A As I indicated before, Mr. Ross, I believe our recommendation was that it would be okay -- or that we recommended that the 230 KV line be allowed to proceed.

Q As I recall, the recommendation was that the type of tower structure be delayed until a decision was made on 3 and 4. Will you assume that that is what the recommendation was, and assuming that, if that was the recommendation, don't you think that we would be in a real bind now to be getting power out of units 1 and 2 in the summer of '76?

A What is the point in assuming it when I don't believe it to be the case?

Q That wasn't my question. I'm asking you to assume that that was the Department's recommendation, and I'm sure the board has their own version of this. But assume that the Department's recommendation was to wait until a decision was made on units 3 and 4, don't you think in view of what has happened, that we would be in a real bind now to try to get power out of units 1 and 2?

A I really couldn't say. I could say that it's been our experience in working with some of the land owners, and working with the Montana Power Company, that perhaps things could have been expedited in getting the approval or the right of way easements required.

Q On page 5 at line 21 you indicate when the decision -- you made a decision to recommend denial with regard to this project. Can you give me the approximate date when that decision was made?

A When the final decision was made?

Q Yes.

A Oh, let's see, I think it was the middle part of January sometime.

Q When did you hire the law firm of Mr. Shenker?

MR. SHERIDAN: Mr. Hearing Officer, as I understand it, the record of the hearing before the Board of

Natural Resources is -- or, before the Board of Health, is being made available to the Board of Natural Resources. Am I correct?

HEARINGS EXAMINER: That's correct.

MR. SHERIDAN: Then I object to this on the basis that it is repetitious of Mr. Ross' examination of Mr. Wicks during those hearings.

MR. ROSS: I don't think I ever examined Mr. Wicks during those hearings.

HEARINGS EXAMINER: I'll overrule the objection. It'll take less time to have him give the date than it will to discuss it.

A November is the answer.

Q Of what year?

A 1974.

Q On page 6 of your statement you discuss the demand for electricity.

A Yes.

Q Do you think there is a demand for the electricity from units 3 and 4 in the applicants' service areas?

A Some demand, yes.

Q Do you think there will be deficiencies in the applicants' service areas if units 3 and 4 are not built?

A Based on your -- no. That depends on whether or not the applicants pursue the alternatives. The applicants project a deficiency in the absence of units 3 and 4; however, there are other alternatives suggested that may reduce that deficiency.

Q But you do think there is a deficiency in this --

A As I stated before, we believe there is a need for some power in Montana Power's service area, yes.

Q How about in the other applicants' service areas?

A I think, as Mr.Shah testified, if I recall, that there is a need for some power, at least for firm power, in one year between now and 1985.

Q The studies that you -- and trends that you refer to on page 6 on demand of electricity --

A Yes?

Q Are any of those related specifically to Colstrip 3 and 4 or the applicants' service areas?

A I believe some of the projections I've looked at from BPA are obviously related.

Q How are they related?

Q Well, as I -- I believe BPA deals with wheeling power in this area, and the five applicant companies would be reflected in some of the BPA projections.

Q Are you aware that a former employee of Bonneville Power Administration testified in this hearing that the load in the Pacific Northwest grew at a rate of 6.8% in 1974 over 1973?

A No, I'm not aware of that.

Q Assuming that is the case, doesn't that contradict your testimony that there has been a decline in electrical demand?

A I believe that my reference on page 6 is to numerous studies throughout the nation which show a general decline -- not a decline, but a decline in the growth rate of electrical energy demand.

Q What studies are those?

A They're not necessarily studies. I get all kinds of reports from the energy industry, and other people, that I review. And just recently, I think, the Wall Street Journal quoting the Federal Energy Administration as one source; the Weekly Energy Report which we get, I believe reported, for instance, in the last few months that there would be substantial excess capacity in the nation, and that the projections, save for nuclear power even, had been reduced by approximately 100,000 megawatts; Electric World also has indicated these reductions in demand; Edison Electrical Institute has also indicated the same thing.

Q Do any of those studies relate specifically to the demand in any of the applicants' service areas?

A None of the studies that I quoted did, no.

Q Do you realize that in the Puget Sound Power and Light Company's service area, that the growth in 1975 over 1974 was at 7.4% rate?

A Do I realize that? No.

Q Did you realize that Puget's load growth in 1973 was less than that 7.4%, but that it has picked up since 1973?

A I am fairly certain that Mr. Shah took those things into consideration when he evaluated the projected energy demand for the five applicant companies, which was discussed yesterday.

Q Doesn't Mr. Shah, in fact, project that the loads of the five applicant companies will grow at a rate in the neighborhood of 6% a year.

A I don't recall that specific point in Mr. Shah's testimony. I believe the only -- one of the few things I remember from the testimony is the amount of energy, average energy or firm energy, that would be needed by 1985 by the five applicant companies.

Q That did show that they have a deficiency; isn't that correct?

A For one year.

Q And the one year is based upon Mr. Shah's assumptions; isn't that correct?

A I believe Mr. Shah used the applicants' figures in arriving at his conclusions with regard to projections of demand.

Q But didn't he, in fact, factor in other assumptions?

A Such as?

Q Such as the use of oil and gas turbines?

A I believe the applicants themselves listed those as resources, and Mr. Shah considered them, yes.

Q You're sure of that?

A I believe from what I overheard in the testimony, yes.

Q Did you have the benefit of Dr. Shah's study at the time you made your recommendation?

A No.

Q Turning to Montana, are you aware that there have been a number of Montana rural electric cooperatives that have testified in this hearing?

A Yes.

Q Are you aware that they have testified that their loads are growing at an unprecedented rate?

A I don't know that they used those words. I recall that their loads are growing. They made the statement that their loads are growing, yes.

Q Do you think their loads are growing at a rate greater than they have in the past?

A I would suppose that they would be growing at a rate greater than they have in the past, depending upon what time period you're talking about. I'm sure that if we go back to the beginning of rural electrification, that the rates of growth were substantially higher than they are today.

Q How about in year 1975, do you think the Montana co-op loads are growing at a greater rate than they did in the early part of the '70's?

A I would think it would depend on the area you're talking about. In some cases it could be; in some others, in my opinion, it probably wouldn't be growing as fast.

Q Do you know of any co-op's whose loads in Montana have declined?

A The last time I took a look, I don't recall any absolute decline in loads, but there was certainly variable growth rates in the rate.

Q Did you take into consideration the fact that the loads of the co-op's as testified by the co-op's in this hearing, are growing? Did you take that into consideration when you made your recommendation?

A I believe that you're talking about Montana now, right?

Q Right.

A Yeah, well, I think the basis of our recommendation was, in that instance was, were the figures supplied by Montana Power Company? So, if you took them into consideration, we took them into consideration.

Q Are all of the co-op's' loads served by Montana Power Company?

A Are all the co-op's' loads --

Q In Montana served --

A I don't know.

Q Did you make any independent analysis of the applicants' loads as originally submitted to you?

A Yes.

Q What were your findings?

A Well, our findings were outlined in the draft environmental impact statement.

Q Did you make any independent studies on the co-op loads in Montana?

A No.

Q Don't you think that's a significant omission?

A We used the figures that were supplied by the Montana Power Company, even as a basis for our own projections.

Q But isn't it true that a lot of co-op's in Montana don't get their power from Montana Power Company, so they wouldn't be reflected in the figure given to you by the applicants?

A Are you making that statement to me?

Q I'm asking you, isn't that true?

A I answered that question before. I said I don't know.

HEARINGS EXAMINER: Do you have much more cross, Mr. Ross?

MR. ROSS: Yes, sir, I do.

HEARINGS EXAMINER: Well, let's recess until what time in the morning? How heavy a schedule have you got tomorrow, Bill?

MR. SHERIDAN: I'd like to start at 8:30 if possible, Mr. Hearing Officer. I have three additional witnesses tomorrow: Dr. Hindowi, Dr. Gold, and Dr. Gorden. And I must move them along because Dr. Gold and Dr. Gorden will not be available after Sunday.

HEARINGS EXAMINER: Any problem anyone else has?

MR. PETERSON: I will not be in a position to cross-examine Dr. Gorden tomorrow, or Friday. The material we received from him, which is quite voluminous, was handed to me Sunday afternoon. I have not -- we mailed it out Monday to our consultant; together with the holiday, he didn't receive it or the plane until Tuesday morning, and I haven't had a chance to discuss it with him, and I will not be in a position to adequately prepare for cross-examination of Dr. Gorden because of the lateness of the service of the statement. I will say that I'd accommodate Dr. Gorden. I realize he's a very busy professor at the university, and I will accommodate him if he's not available next week, sometime whenever he is.

WITNESS: Mr. Davis?

HEARINGS EXAMINER: Yes, Mr. Wicks?

WITNESS: Is it proper for a witness to ask a question regarding timing?

HEARINGS EXAMINER: Sure, you bet.

WITNESS: John, do you have any idea how long it will be. I mean, is there any -- I'm getting ready to go to Washington, and would there be any problem with trying to finish up tonight, or is it too lengthy an endeavor?

HEARINGS EXAMINER: Well, I don't want to crowd the cross-examination unduly. We've been here until a quarter to seven both nights, and there's a certain element of fairness on that side of the coin too. When do you have to go to Washington, Mr. Wicks?

WITNESS: I believe Friday, Carl, but it's the Western Governors Regional Energy Policy Office, and I have to get a number of documents ready for the meeting.

HEARINGS EXAMINER: Well, --

MR. ROSS: I think we can accommodate Mr. Wicks and get him out of here in a good hour in the morning.

HEARINGS EXAMINER: In an hour?

MR. ROSS: I'd say something like an hour. That sound all right with you?

MR. SHERIDAN: In the event that -- or, since Mr. Peterson is not prepared to cross-examine Dr. Gorden, I don't think that he will be available prior to Thursday of next week, and we might give some thought to keeping our case open for purposes of bringing him in at a later date.

HEARINGS EXAMINER: Just keep loose, everybody, and we'll get them all in whenever they can come. We'll just work them in. We'll give everybody a fair shot at all the things. All right. Let's try it at 8:30 in the morning, please.

(RECESSED AT 5:10 P.M.)